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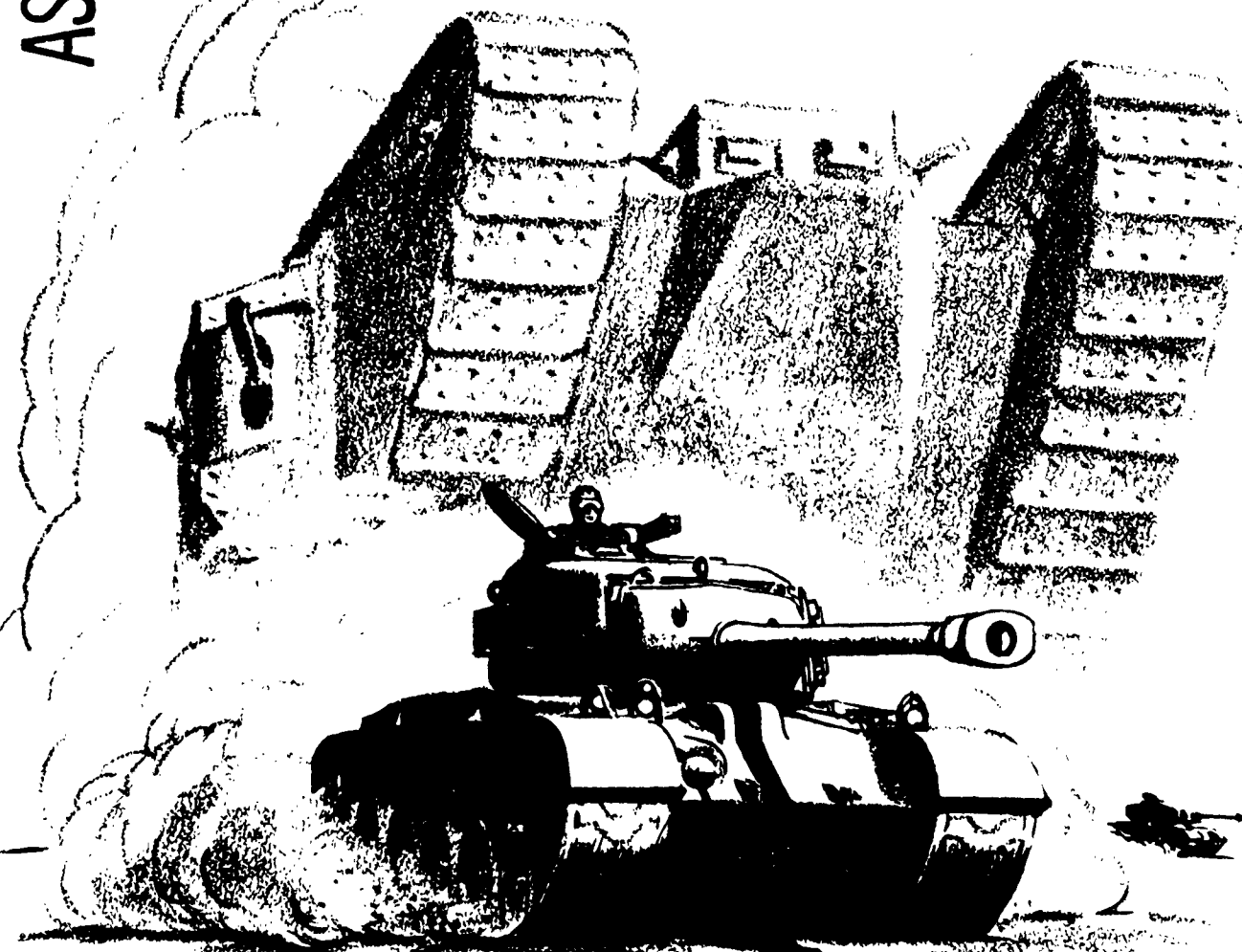
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Terrain, Weather, and Hydrographic conditions in Turkey and adjoining Countries Relative to Their Effect on Armored Employment

VOLUME I



A RESEARCH REPORT

Prepared at
THE ARMORED SCHOOL
Fort Knox, Kentucky
1951 - 1952

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IN TURKEY AND ADJOINING COUNTRIES RELATIVE
TO THEIR EFFECT ON ARMORED EMPLOYMENT

A RESEARCH REPORT PREPARED

BY

COMMITTEE 21, OFFICERS ADVANCED COURSE

THE ARMORED SCHOOL

1951 - 1952

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CHAPTER 1

INTRODUCTION TO THE STUDY

Statement of the Problem

The purpose of the research is to study the terrain, weather and hydrographic conditions in TURKEY and adjoining countries relative to armored employment. The study presents in consolidated form an investigation of existing conditions for movement of armor north to RUSSIA. Consequently, not only the capability of armored movement is explored but also the selection of major avenues of approach is made for the purpose of eventually reaching the heart of RUSSIA located at MOSCOW.

The scope of this paper while considering TURKEY as the center of the study must take cognizance of all the surrounding countries so that the bordering terrain has been covered as to its effect on the approaches to RUSSIA. Consequently, mention is made of the BALKAN COUNTRIES of GREECE, BULGARIA, YUGOSLAVIA, ALBANIA, and ROMANIA. Likewise, HUNGARY, the UKRAINE, and SOUTHERN RUSSIA are discussed so as to cover the entire left flank of the area. The CAUCASUS AREA, and mention of IRAN, IRAQ, and SYRIA, completes the encirclement of the BLACK SEA and covers the entire area of consideration around TURKEY.

The emphasis of all movement is with regard to effecting a lodgement in SOUTHERN RUSSIA with the intention of moving north.

Limitations to the investigation are that only physical characteristics along with man made facilities have been presented. Consequently, no attempt is made to evaluate racial problems or aspects of the industrial, economic, political, and military conditions.

Evaluation and Analysis of the Study Field

Ancient history has established this area as an important link in the east-west invasion routes to EUROPE. The Greeks met the Persians in initial clashes between east and west in this area. Genghis Khan later sent his armies into an European invasion through the northern part of the area.

Modern history of World War I indicated an increasing north-south importance as well as east-west. The German interest in the area led to the Berlin to Baghdad railroad which involved SERBIA and, eventually, precipitated war. The desire of the Allies to open a water route to southern RUSSIA led to the ill-fated Gallipoli Campaign and the establishment of a BALKAN FRONT.

In World War II the clash of armies occurred in the area of the BALKANS to prevent the establishment of north-south communications to RUSSIA. It is of interest to note that in the German BALKAN CAMPAIGN of 1941 Hitler used at least five panzer divisions in a blitzkrieg invasion of YUGOSLAVIA and GREECE. The similarity of these campaigns with the invasion of SERBIA in World War I is so marked as to establish the valley of the MORAVA RIVER in YUGOSLAVIA as the key to the BALKANS and, consequently, an area of contest.

Present day conceptions have continued the importance of the area in the north-south direction because the line-up of forces has shifted and former allies are no longer friendly. The denial of Russian threat to the communication lines of the MEDITERRANEAN, SUEZ CANAL, and RED SEA is of equal importance with the protection of vital oil fields now available to the United Nations in ARABIA, IRAQ, IRAN, and SYRIA. This theater, therefore, represents a potential battleground in which TURKEY stands in the center.

Futuristic Setting

With the historical record pointing to the increased importance of the area, a futuristic setting as a theater of operation is assumed. The inclusion of GREECE and TURKEY as North Atlantic Treaty Organization forces and the neutral political attitude of YUGOSLAVIA has set the frontiers of these countries as the line of battle contact for the future war. To this end TURKEY and the surrounding countries form a theater of operations on the southern flank of RUSSIA.

The events leading to GREECE and TURKEY entering the NATO countries against strong threats from the Soviets have climaxed mostly since 1946. The Communist attacks in GREECE were defeated by United States assistance and military advice. Extensive economic and military aid was then implemented in both GREECE and TURKEY to bolster them as frontiers to contain communist aggression. Though this action has brought fruitful results in these countries, success

has not been too great at the strategic point of TRIESTE. The historical importance of this port area was magnified during Big Four treaty negotiations of 1946. It was then put under United Nations control pending further agreement which has not been forthcoming.

Consequently, current day events point to the inevitable clash of opposing armies on the axis of PARIS-BERLIN-MOSCOW. It is considered as a premise in this study that this northern axis will be the main battle area, and the theater of TURKEY and adjacent countries will form a second front to this main effort. Our present day allies, GREECE and TURKEY, indicate these countries as invasion bases and as a result, this study carries to conclusion only the conception of an invasion to the north.

Review of Research Problem to Date

At present there is a great volume of data already collected concerning the countries of this area. The Joint Army Navy Intelligence (JANIS), the National Intelligence Survey (NIS), the Strategic Intelligence Digests (SID), and many other documents as indicated in the bibliography represent source material already available. Likewise, non-classified documents such as the Encyclopedia Britannica cover each country in a comprehensive manner which when combined with the pictures and articles in the National Geographic Magazine complete an introduction to the present day area.

The actual up-to-date and factual studies being collected by the Central Intelligence Agency in WASHINGTON, D. C. were not complete

at the writing of this paper as they were in draft form and not available for dissemination.

A great amount of the factual data contained in intelligence publications is gathered by the Army Map Service (AMS) where complete study sections literally exhaust the informational sources of each country making the effort here a little pale by comparison to their sources and files.

The Office of Naval Intelligence (ONI) has very complete source material in regards to navigation, beach conditions, and ports and harbors of all the bodies of water in the area.

The River and Harbors (Corps of Engineers) study sections have full factual data on ports which are as extensive as any source available.

It is of interest to note that British Naval Intelligence (JIB) reports and earlier documents have contributed the ground work for later studies and formed the initial basis for the compilation of our present files of information.

"History of World War I," by McEntee, who collected his data from a large formidable list of authorities, represents a sizeable contribution in the field of terrain evaluation in this theater. History pamphlets from the United States Military Academy, likewise, have contained excellent evaluations of this area.

However, not a single source available to the committee has compiled an analysis from the standpoint of a southern invasion of RUSSIA from the vantage point of TURKEY. Consequently, this study

represents creative thought by the research committee.

Definition of Terms

The term "BALKANS" or "BALKAN PENINSULA" is used in this research as an all inclusive area comprising GREECE, ALBANIA, YUGOSLAVIA, BULGARIA, ROMANIA, and HUNGARY. The true definition of the "BALKANS" is not as inclusive as this and is considered by some authorities as only the countries surrounding BULGARIA where the range of mountains called the BALKANS exist.

"SOUTHERN RUSSIA" pertains to all of RUSSIA that borders the BLACK SEA five hundred miles from the coast. This includes such areas as the UKRAINE, the CRIMEA, and the nook of land between the BLACK and CASPIAN SEAS referred to as "TRANS-CAUCASIA" or the area of the CAUCASUS.

Method of Research

Each member of the committee initially studied a single country and then read generally of the entire area. As soon as the general knowledge of each individual had been expanded to include the area as a whole, each member took a single subject such as topography or railroads and wrote the entire chapter devoted to that topic.

In most research projects the authors have a basic knowledge of the subject and then develop a greater detailed study. In this case it was necessary to start from the very beginning to develop the basic knowledge and then progress to specific items in detail. Consequently, while the paper may seem lengthy it is in reality a brief consolidation of many voluminous documents.

One of the great difficulties was to find a suitable map from which to present the various details without inclosing a dozen map sheets. Oddly enough the best ready references were the National Geographic Society maps of the area, a copy of which has been inclosed in the back of this volume.

Organization of the Research

The first subject discussed is the configuration of the land contained in the first two chapters on topography. Here the mountains, major rivers, and general terrain considerations are presented as the initial concept to the area as a whole.

Standing next to topography and of equal importance, is the climate of the area. This is truly a brief so as to give only the essential basic information to the area as it affects armored movement.

The succeeding five chapters deal with transportation, coasts, landing beaches, and cross country mobility so as to provide an insight into the problem of movement throughout the theater. The consideration of these chapters is of paramount importance to the selection of bases and lines of communications.

The final two development chapters deal with strategic areas as the objectives to any operations and the strategic routes of approach as the avenues of reaching those objectives. These chapters represent the culmination of the study and represent the why and the how of offensive operations.

The summary, while couched in general terms represents the considerations, conclusions, and recommendations of the research. The conclusions reached by all members of the committee were identical and only varied slightly from the standpoint of degree.

CHAPTER 2

TOPOGRAPHY

TURKEY AND THE USSR

This chapter is the first of two which discuss the topography (mountains, rivers, soils and vegetation) of the entire area under study; the area encompassed will be that of TURKEY, the CAUCASUS AREA, and a strip of the USSR around the BLACK SEA. Each area will be discussed in turn as a sub-chapter heading with the various topographic subjects given a place under the sub-chapter heading.

Turkey

The discussion of the topography of TURKEY will be limited and general, giving little more than an introduction to the subject and an idea of the facts upon which conclusions of the committee will be based. More detailed information may be found in NIS 27, TURKEY, Chapter II, MILITARY GEOGRAPHY, Central Intelligence Agency, Washington, 25, D. C.

Relief - The general relief of TURKEY is complex and varied, being on the whole mountainous and rugged. There are four general mountain ranges. The PONTUS MOUNTAINS, the TAURUS MOUNTAINS, the ALPUS MOUNTAINS and the ANATOLIAN MOUNTAINS form the major part of the relief of the country, the remainder being given over to the region around the SEA of MARMORA (the STRAITS REGION) and the CENTRAL PLATEAU REGION.

The PONTUS MOUNTAINS are a rugged range which parallel the

BLACK SEA for practically the entire length of the north coast of TURKEY with altitudes that increase eastward from 4,000 to 10,000 feet. These mountains are a complex system of eroded hard rock, granite, lava, and volcanic ash, and, for a great portion of their length, they resemble the APPALACHIAN MOUNTAINS, with their rounded summits and generally uniform elevations. A narrow and discontinuous coastal plain exists between the heights and the sea while, within the ranges, the principal valleys are troughlike depressions which parallel the trend of the mountains. Only a few large rivers, cutting their way through narrow gorges and canyons, cross the range. Generally cross country movement is slow and difficult, and the PONTUS RANGE constitutes a major barrier to communications with coast and interior.¹ Along the southern coast of TURKEY the TAURUS MOUNTAIN system parallels the MEDITERRANEAN SEA; it is divided into three sections by the KOPRU RIVER and the KAKCAY RIVER. The western portion consists of rugged limestone ranges and plateaus dissected by narrow crooked valleys some of which are 1000 feet deep with precipitous walls. The peak elevations in this western sector range from 5000 feet to 9000 feet.

The middle section of the TAURUS between the KOPRU and KAKCAY RIVERS is a high broken up limestone plateau with elevations averaging 7,800 feet. Large enclosed basins and tremendous gorges interrupt the surface of the plateau and are serious obstacles to movement.² Immediately on the coast and on the eastern two-thirds of this area is a terrace of approximately 1600 feet elevation; this

terrace touches the coast at several points and interposes minor obstacles along the coast road that has to traverse it.³

The eastern portion of the TAURUS again takes on an extremely rugged, mountainous aspect cut up by deep and difficult gorges. Through this area crosses the only good road from ADANA to the CENTRAL PLATEAU over the pass known as the CILICIAN GATES, which is a series of defiles cutting through the range.

The AMANUS MOUNTAINS are a barrier range which extend in a north east direction from the GULF of ALEXANDRETTA. Starting steeply from the plains, they rise to rugged crests with elevations varying from 4,500 feet to 7,400 feet. Generally, ridges are broad and round with forested shoulders and have a few bare peaks rising from them. The western side of the range is steep and cut up with gorgelike valleys while the eastern side is relatively smooth though steep.

Three passes provide a way of crossing the AMANUS MOUNTAINS. The first is BEKAN PASS (2,230 ft) which is not very difficult to negotiate and is located southeast of ISKENDERUN. The next is HASANBEYLI PASS which crosses the mountains, at approximately 4000 ft by way of a steep, winding road. The third pass is north of the HASANBEYL PASS and is called BAHCE PASS. This has a three mile tunnel which, at an altitude of 2,420 ft, carries the railroad across the range.

The ANATOLIAN MOUNTAIN REGION is a complex system of rugged mountains and high plateaus, the plateau area extending generally

from the CENTRAL PLATEAU east to the border of the USSR and surrounded by the northern and southern ranges of the ANATOLIAN MOUNTAINS.

The northern ANATOLIANS form a belt 10 to 30 miles wide along the northern edge of the region. Throughout most of its length the chain rises steeply on both sides and attains elevations of from 9000 ft to more than 11,000 feet.

The southern ANATOLIANS initially form a belt approximately 30 miles wide along the southern edge of the region and gradually expand until they include the entire southeastern corner of TURKEY. As the mountains trend east they become steeper and more rugged and complex until, along the border of IRAN, travel through them is possible only with donkeys and at great risk.⁴

The plateau area in the east is a rolling upland with numerous volcanic cones of moderate size, and as it trends westward, it becomes a complex of extensive rolling uplands and steep and hilly mountainous lands.

East-west travel in the ANATOLIAN REGION is provided with relatively easy routes, but north-south movement is, in general, difficult.

The CENTRAL PLATEAU is bounded on the north by the PONTUS MOUNTAINS, on the east by the ANATOLIAN REGION, on the south by the TAURUS MOUNTAINS, and on the west by the STRAITS REGION; it is an area of rolling uplands and basin plains and lies at about 4,000 ft above sea level. Slopes throughout the area are gentle, usually less than 10%; but volcanic mountains and scattered ridges do rise above

the general level of the plateau. These outstanding features of relief are easily by-passed, however, and during dry weather movement throughout the area is comparatively easy for troops and vehicles.

The STRAITS REGION consists of EUROPEAN TURKEY and that part of ASIATIC TURKEY west of the CENTRAL PLATEAU. The European portion consists of a broad central plain, the ERGENE PLAIN, bordered on the north by rugged mountains rising steeply from the BLACK SEA to about 3000 ft and on the south by low flat topped hills with heights of from 500 to 600 ft. The ASIATIC portion of this section consists of a series of valleys and ridges with an east-west trend which make north-south movement difficult. At the heads of most of the valleys, steep slopes mark the ascent to the CENTRAL PLATEAU.

Rivers - TURKEY is cut up by many large rivers of varying degrees of importance to a strategic study; a glance at the map will show some of them. Since extremely detailed information on all Turkish rivers having military considerations has been compiled in the document mentioned at the beginning of this chapter, and since this document should be available to anyone interested in this study, that detailed data will not be recapitulated here. Instead, a brief general discussion of the rivers and drainage will be given, and for ease of discussion, the country will be broken down into the general topographic sections mentioned above under relief: the STRAITS REGION, the CENTRAL PLATEAU, the PONTUS MOUNTAINS, the TAURUS MOUNTAINS, and the ANATOLIAN HIGHLANDS.

In the STRAITS REGION all streams are obstacles both in EUROPEAN and ASIATIC TURKEY.⁵ During July and August the smaller streams usually dry up, but in December all rivers and streams are at their maximum flow; during this high water stage the streams become unfordable. High waters and floods also occur during March when the snow is melting thus again rendering many streams unfordable. In EUROPEAN TURKEY a significant marsh barrier follows the line of the lower MARITZA RIVER as it flows into the AEGEAN SEA.

In the CENTRAL PLATEAU region most streams are intermittent, although there are some important perennial rivers that flow through the area; the SAKARYA and KIZIL IRMAK are the two largest of these. In the summer the majority of streams in this region dry up altogether, and often the beds are used for roadways; however, during the wet season from November to May the many wadis, rivers, and lakes may have high water, and, together with the wet and soft soil, limit or even prevent cross-country movement.⁶ In April and May the snow thaws, and streams reach their highest level and flow with their greatest velocity; during this period even the small streams are difficult to cross. Few of the streams rising in or flowing through the CENTRAL PLATEAU ever reach the sea.

Many lakes dot the CENTRAL PLATEAU section; some are salt and others fresh. During the high water period they rise and spread out over adjacent flats, then in the dry summer they diminish considerably in size, some even disappearing altogether. A large number of unmapped, seasonal lakes are reported to be in this area. In the

wet season they occupy basins on the plateau and in summer disappear completely leaving black morasses or dry white salt crusts.

The PONTUS MOUNTAIN REGION contains a great many perennial streams which are thicker than in any other area in TURKEY, usually being less than 1.2 miles apart. The majority of these rivers rise in the mountains near the coast and flow for just a short distance into the BLACK SEA; however, they have relatively large dependable flows, even the small creeks flowing throughout the year. Here, as elsewhere, the high water comes in the spring with the thaw and melting snow, and the streams add to the difficulty of movement in the area. Throughout the region delta plains, occurring where the streams debouch into the BLACK SEA, are marshy the year round and difficult to cross at any time.

The rivers and streams in the TAURUS MOUNTAIN REGION exhibit the same great seasonal fluctuations that is usual in streams of other countries existing in the Mediterranean climatic zone. During the winter they swell, reaching their highest level during the spring snow thaw, and often bringing devastating floods. At this time much damage is done to bridges and causeways, cultivated land is washed away or overlaid with debris carried by the water, and it is often dangerous or even impossible to attempt to ford even minor streams. With the coming of midsummer the volume of water decreases greatly, and while the large rivers, fed by the lakes and snows of the higher mountains, are perennial, the smaller streams dry up. Before the streams reach the coastal plain their gradient is steep;

consequently, broad alluvial fans are formed at the exits of the mountains from the debris carried down by the water. Once into the coastal plains, the gradient becomes very slight, and the rivers follow winding courses bordered by abandoned channels and marshy lowlands. Barrier marshes of some significance exist in the ADANA PLAIN along the coast between the CEYHAN and SEYHAN RIVERS and upstream along the CEYHAN for approximately 50 miles. These marshes also fluctuate with the seasons, but they are never completely trafficable.

The waters of the ANATOLIAN HIGHLANDS differ little in their characteristics from the waters of the other region of TURKEY already discussed. Most of the rivers and streams in the region can be forded in late summer or early fall during the low water stage. As in the other regions, the high waters come during the winter reaching their maximum in early spring; during this period flooding is extensive in the basins, and fording everywhere is difficult. The most significant marsh areas in this region lie in the ARAXES RIVER VALLEY along the USSR border and are an obstacle to movement. These marsh areas are extensive and probably not traversable during any period of the year; however, they are not continuous and can probably be by-passed.⁷

Soils - The greater portion of ASIATIC TURKEY is covered with a mixed shallow and deep loamy soil that is well drained; this soil is slippery when wet but dries quickly and is dusty after rains. In the ERGENE PLAIN of EUROPEAN TURKEY, the soil is a

mixture of silt and clay with poor drainage; these soils tend to dry slowly, are extremely sticky when wet, and are hard when dry. Many areas of low elevation in TURKEY are covered with alluvial soils; these tend to get waterlogged when wet and become soft and fluid when saturated. The CENTRAL PLATEAU REGION has the greatest variety of soils of any region in the country; in addition to the mixed shallow and deep loamy soils, it has soils ranging from well drained deep loam or sand to silt in the large basins and on the table lands.

Vegetation - Along the coastal areas of TURKEY below 2,000 ft, the vegetation consists normally of scrub and brush, grass, crops, and marsh plants. The scrub and brush grows to from six to nine ft high and is dense and sometimes thorny. Depending on the area, evergreen usually makes up most of the brush.

In the ERGENE PLAIN and other interior lowlands of EUROPEAN TURKEY grass and crops form the mass of vegetation.

From 2,000 to 4,500 feet in the mountains the vegetation is generally deciduous forest with dense underbrush grading into coniferous forest at about 4,500 ft; from that altitude to timberline (6,000 to 7,000 ft) coniferous forest makes up most of the vegetation.

In the CENTRAL PLATEAU REGIONS most of the vegetation is steppe grass; however crops have been cultivated in the valleys, groves of trees have been planted along the streams, and patches of coniferous forest exist on the high pieces of terrain.

The Caucasus Area⁸

The CAUCASUS AREA is a broad isthmus lying between the BLACK SEA and the CASPIAN SEA. It has an area approximately equivalent to the NEW ENGLAND STATES plus NEW YORK, NEW JERSEY, and PENNSYLVANIA⁹; it connects TURKEY and IRAN with the southeastern part of the USSR. The topography of the area is one of extremes; there are glaciers, vast snow fields, extremely rugged mountains, rich alpine pastures, trackless forests, desert lands, and fertile rolling or level grass lands.

Relief - As mentioned above, the CAUCASUS is noted for its unusual variety of natural features; although the area is dominated by mountains, it does contain plains and extensive lowlands.

On the north lies the extensive PRECAUCASIAN LOWLANDS, which are a southern extension of the great plains of USSR. The area is divided roughly into two distinct parts by the STAVROPOL HILLS which rise from the plains to an average height of only a few hundred feet. To the west of the hills is the AZOV-KUBAN region, which is a fertile grassland with a level to rolling surface that slopes down to the SEA OF AZOV; to the east of the STAVROPOL HILLS is the CASPIAN LOWLANDS. This area is a vast, level, and little cut up plain which is largely the dried bed of the CASPIAN SEA; in places the levelness of the area is broken by elongated lakes and marshes, patches of hilly sand dunes, and by the various rivers. As a whole the PRECAUCASIAN LOWLANDS offer few obstructions to movement.¹⁰

South of the lowlands are the MAJOR CAUCASUS MOUNTAINS (BOL'SHOY KAVKAZ); these mountains are a series of parallel chains extending from the northeastern shore of the BLACK SEA to within a few miles of the CASPIAN SEA, a distance of some 740 miles. The average width of the chain is from 60 to 80 miles across with the narrowest portion being 20 to 25 miles in the lower western ranges. The high central sector contracts to 50 miles at one point. The steep ragged peaks, largely schist, granite, and limestone, increase in average height from 1,600 ft near the western end to 12,000 - 13,000 ft in the center, and then decline to 8,000 - 10,000 ft in the east. The elevations decline rapidly near the CASPIAN SEA, and a narrow coastal plain, 3 to 5 miles wide, is left, broken only by a few rounded foothill spurs.

Between the main CAUCASUS MOUNTAINS and the next system to the south, the TRANSCAUCASIAN HIGHLANDS, lies the TRANSCAUCASIAN LOWLANDS, two triangular shaped areas. On the west facing the BLACK SEA is the RIONI DEPRESSION, and facing the CASPIAN SEA on the east is the KURA DEPRESSION. The eastern apex of the RIONI is separated from the western apex of the KURA by an 80 mile wide belt of low plateaus and ranges which link the mountain systems on the north and south. Both areas are relatively flat and slope gently to their respective seas. The KURA depression lies in part below sea level and is much the larger of the two lowlands. Both depressions have rivers along the lower courses of which lie swamps and marshes which do not freeze firm in winter nor dry out in summer.

The TRANSCAUCASIAN HIGHLANDS are a nearly oval block, broken up into three major divisions. First, on the north is a short, east-west, moderately rugged series of unconnected ranges with elevations from 6,500 to 10,000 ft. In the extreme south and southeast, paralleling the boundary with TURKEY, is a series of low narrow basins, the floors of which, while relatively flat, exceed 2,000 ft in elevation. The third division consists of the greater part of the area, which is a level plateau or series of plateaus varying in level from 3,000 to 6,500 ft and broken by low ranges, a few lakes, streams, and many isolated volcanoes, 10,000 to 12,000 ft high. No natural barriers exist along the borders with TURKEY and IRAN. In the borderlands cross-country movement is easiest because the lower elevations, less snow, and scant vegetation make the TRANSCAUCASIAN HIGHLANDS more amenable to movement than the main CAUCASUS to the north.

The last portion of the CAUCASUS AREA is the ARMENIAN PLATEAU, lying south-east of the TRANSCAUCASIAN HIGHLANDS. This plateau is composed largely of erupted volcanic rocks. The highest peak in the area is an extinct volcano 13,454 ft high. Numerous lakes are scattered over the plateau, and various streams deeply dissect the dry uplands. The diversity of ground forms hinder cross-country movement which is restricted more or less to roads.

Most of the higher peaks and ranges are covered with snow all year round. The snow line varies from 8,800 to 12,500 ft, and several important passes are near that line. Movement through the high, rugged, snowy, central ranges is difficult in summer and

impossible in winter except over one or two military roads; other difficulties of crossing the higher and broader parts of the ranges lie in the steep gradients in narrow stream filled valleys, landslides, and snowslides. These difficulties are similar to those encountered in the ALPS and northern ROCKY MOUNTAINS. In spite of these handicaps, the CAUCASUS has never been a completely effective barrier to military operations.

Rivers - The mountain streams of the CAUCASUS are typically torrential; falls and rapids are common, and deep gorges exist along the course of many streams. Floods begin in late spring with the thaw and are kept up throughout the summer by the melting snow and ice at higher altitudes.

As the major rivers reach the lowlands their characters change; gradients are lessened, and currents are slowed. Widths generally increase, and courses may become meandering and braided depending on the levelness of the ground; marshes may develop along the courses. The slower run-off period on the plains results in flooded land at fairly regular periods.

The nature of beds and banks varies with the location of the streams. In the mountains beds are sharply inclined in places and are composed mostly of boulders, shingle, and cobble. Banks are usually steep and high. The beds of streams crossing the plains are less stony and consist of sand, silt, and mud, and as a consequence the banks are lower and usually firm.

Depths of water vary greatly from stream to stream and from season to season. Greatest depths during normal flow occur in the lower 100 miles or more of the KUBAN, TEREK, KURA, and ARAXES RIVERS where five foot and deeper is common.

Generally, rivers and streams in the CAUCASUS offer little obstruction to cross-country movement except at flood stage.¹¹ Usually such high water obstruction is localized and can be easily by-passed. The major streams, however, lie generally east and west across the probable routes of approach through the area. Swiftly flowing streams are normally located in terrain where by its ruggedness is more important to movement considerations than are the streams themselves.

Soils - Since the subject of soils in the CAUCASUS AREA is fully covered later in this report under cross-country movement, it will not be discussed in detail here.

Vegetation - Like all other natural features in the CAUCASUS the vegetation is extremely diverse. The distribution over the area is about as follows: marsh vegetation less than 5%, drought resistant shrubs and herbs 5%, low growing vegetation from semi-desert type herbs and grasses through steppe grass to the thick grass of the alpine meadows 25%, forest 20%, crops 40%, and the remaining 6% or so is lakes, rivers, sandy coasts, bare mountain peaks, dwelling sites, and transportation routes.¹²

The forests vary greatly in density and penetrability. In some places choking undergrowth and swamp makes movement off the

road impossible; however in the greatest part of the forest area undergrowth does not exist, and the ground, being mostly mountainside, is well drained.

In the shrub and herb areas concealment is meagre; this is true also of the grass areas.

The Ukraine and Southern U.S.S.R.

This area will be covered very briefly, almost meagerly, since, although it is an area over which any force from the BALKANS or TURKEY must operate, it should more logically be made the subject of another study. The area extends roughly from the PRUT RIVER and CARPATHIAN MOUNTAINS east to the SEA of AZOV and the CASPIAN SEA and extends approximately 350 miles inland from the coast of the BLACK SEA.

Relief - The terrain throughout this area is a slight barrier to movement consisting of plains, having scattered hills and many areas of swamp, and low hill masses with many wide valleys and upland flats.

A range of low hills of from 600 to 1,600 feet parallel the line of the CARPATHIANS and generally follow the line of the DNEISTER from CONSTANTIA in ROMANIA, to LVOV; they average 50 miles in width. Another range 250 miles long by 40 miles wide extends in a northwest - southeast direction from KIEV to near DNEIPROPETROVSK. A similar low hill mass exists in the vicinity of STALINO. The last two complexes are less than an average 700 feet in altitude. The rest of the area is rolling plains.

Rivers - Many major rivers flow generally south in the area and form obstacles to west-east movement; some of these are the DNEISTER, DNEIPER, and the DON. The barrier effect of these streams is increased by floods during the time of thaw; marshes frequently line their courses.

Soils - The area is covered with grassland soils; these form deep mud quickly but dry as quickly after rains or thaws except in marsh areas. During the spring thaw season, even men on foot find these soils almost impassable.

Vegetation - The natural vegetation in this area is mostly steppe grass with trees lining many of the streams. Little of the original steppe remains, however, since cultivation has taken place in all but a very few large expanses. Concealment in the area of grasslands is almost entirely lacking except in the small wooded areas such as stream lines.

NOTES FOR CHAPTER 2

¹ Turkey, Chapter II (Washington, Central Intelligence Agency, 1948), Table 26-1.

² Ibid., p 26-81.

³ Ibid., p 40-75.

⁴ Ibid., p 26-135.

⁵ Ibid., Table 26-1.

⁶ Ibid., p 26-110.

⁷ Ibid., p 26-139.

⁸USSR, The Caucasus Area Janis 41 (Washington, Intelligence Division, General Staff, Dept of the Army, 1949) - Detailed information on the Caucasus Area in greater length than that in the sub-chapter is available in this reference.

⁹Ibid, p 11-1.

¹⁰Ibid, p 11-2.

¹¹Ibid, p 11-7.

¹²Ibid, p 11-11.

CHAPTER 3

TOPOGRAPHY

THE BALKAN PENINSULA

In this chapter the topography, (mountains, rivers, soils, and vegetation) of the countries of the BALKAN PENINSULA will be discussed. According to the latest definitions the BALKAN PENINSULA does not embrace those territories included within the boundaries of ROMANIA and HUNGARY and the mountains and rivers bounding those countries; however as these areas must be passed through in order to reach the plains of RUSSIA they will be considered in this study.

The chapter will be broken down into three general parts; the first will embrace a discussion of the mountain ranges found on the BALKAN PENINSULA, the second will discuss the major rivers of the peninsula, and the third will cover each country with which this study is concerned, in turn, discussing relief, rivers, soil, and vegetation of each.

The Mountains of the Balkan Peninsula

BALKAN is a Turkish word meaning "mountain", and a glance at the map will show that it is an appropriate name for that peninsula. The mountains which abound on the terrain known as the BALKAN PENINSULA are the most outstanding topographical features of the area. They will be discussed here as separate mountain ranges without regard for the boundaries of states.

The Dinaric Alps. This mountain chain connects the true ALPS with the mountains of the BALKAN PENINSULA. Rising abruptly from the sea, the chain parallels the coastline in a south-eastern direction. As it passes from the northwest to the southwest the range widens from about 40 miles across on the line from FIUME to ZAGREB to about 120 miles from SCUTARI to KRAIJEVO.

The DINARIC ALPS attains an average height of 5,000 ft with few rising higher than 9,000 ft; the highest point is in ALBANIA and reaches nearly 9,000 ft. During the winter they are covered by deep snows.

Although the heights are not great, these mountains are an effective barrier between the coast and the interior due chiefly to the "Karst" formations. Karst is a condition that develops when massive limestone beds have undergone a great deal of subterranean dissolution. This karst extends from TRIESTE over 450 miles southeastward to MONTENEGRO. In places it is almost a 100 miles wide, approximating the area of NEW YORK STATE.

The karst causes the surface of the mountains to become extremely rough and uneven, the limestone formations having been heavily eroded by the solvent action of some of the most severe rainfalls of EUROPE. In places the limestone is broken up by irregular furrows which border rough, sharp-edged projections of rock; in other places rounded funnels or pans of various dimensions break up the surface. In general, however, the karst is a maze of irregular forms which recur monotonously over large areas.

The water drains off quickly in the karst areas and transports most of the soil with it which tends to make the ground intractable. The joints and crevices in the rocks allow the water to transfer most of its circulation to the interior of the mountains.

A feature of the DINARIC ALPS in the karst region are the large valleys which exist in the interior reaches. These valleys often measure 100 square miles or more and are drained only by sink holes. Since the soils are fertile and well drained, people have settled and built up centers of population and industry here. These areas are generally reached only through deep narrow gorges.

The range of the DINARIC ALPS can be considered as being broken into three zones: (1) The islands and peninsulas along the coast which were created when the coastal range was submerged--this belt is separated from the interior karst by a line of steep cliffed hills; (2) The karst, which includes the KAPELLA ranges and the mountains west of ZAGREB--many of the basins and depressions have steep walls, and the floors are often only 200 ft above sea level; (3) The PLANINA region further inland and to the south--here the elevations increase with notable heights being DURMITOR, 8,234 ft, and MAJLIC, 7,840 ft.

In ALBANIA the ALPS parallel the coast in a northwest-southwest direction beginning about 30 miles inland. The inaccessability and relief of these mountains have been increased by glaciation and severe erosion of the limestone which predominates in the formation. The altitudes in this area run over 6,000 ft

in many cases with the highest point being almost 9,000 ft.

The Pindus Mountains. These mountains form the main range of GREECE; they extend down through the center of the country in a northwest to southeast direction for 160 miles. They extend into ALBANIA and form the major portion of the mountains in that country and run generally north and south.

In ALBANIA the PINDUS MOUNTAINS are extremely broken up by earth movement, and erosion of the sandstone and limestone formations has caused rounded land forms. The terrain is extremely cut up by rivers, however, and, in spite of the rounded land forms, displays considerable relief. Several altitudes reach over 8,000 ft with MT. TIMOR going to 8,200 ft. Some small valleys are enclosed by the heights, and the floors of these depressions go as low as 650 ft above sea level.

In the southern portion of the area the limestone ridges increase in height and then drop away to 6,000 ft.

In GREECE the PINDUS range varies from 40 to 60 miles wide throughout its 160 mile length, is very rugged, and is an effective barrier to east-west traffic.¹ The heights reach a maximum of 7,500 ft and are well watered and heavily wooded with the summits being rounded and bare. To the south the altitudes decrease, but the relief remains rugged.

The valleys which exist within the mountain range are deep and narrow, with either no flood plains or very narrow ones.

There are two narrow passes through the PINDUS area from east to west. (1) The METSOVAN PASS at an altitude of 5,000 ft connecting KALABAKA and JANNINA via the ZYGAS RIVER. During the months of January and February this route is blocked with snow. (2) The pass near MT. TIMFRISTOS in the south connecting the SPERKHOS VALLEY and KARPENISION. This, too, may have travel through it impeded for a week or more by a snow storm.

Two passes also exist for north-south traffic between GREECE and YUGOSLAVIA, (1) the MONASTIR GAP and (2) the valley of the VARDAR RIVER.

A second mountain mass juts out from the PINDUS MOUNTAINS and forms a semi-circular curve east to the GULF OF THERMAI. The majority of the elevations are about 2,000 ft with MT. OLYMPUS being the highest point at 9,571 ft. The relief is characterized by isolated highlands and steep seaward slopes. Low passes separate the main mountain masses.

Throughout the PINDUS and other Grecian mountain areas ground movement is channeled through gorges, passes, and corridors, and even then it is limited to carefully reconnoitered or previously prepared trails.²

The Rhodope Mountains. These mountains run generally east and west and form the border between BULGARIA and GREECE. They are bordered on the north and east by the RUMELIAN PLAIN, on the southwest by the MACEDONIAN PLAIN, and on the southeast by the AEGEAN COASTAL PLAIN.

The RHODOPE chain is made quite rugged by the hard rocks forming it, and glaciation has formed U-shaped, gouged valleys, circular valleys with precipitous walls, and ridges to add to the difficult relief. The altitude averages 7,000 ft with the highest point reaching 9,500 ft.

Many portions of the RHODOPE range are heavily wooded, and the general wildness makes it an excellent one for refuge and, it would seem, for defense.

There are two minor passes through these mountains in a north-south direction, both through river valleys--the STRUMA and the NESTOS. The STRUMA is the more important of the two.

The Balkan Mountains. The BALKAN MOUNTAIN RANGE begins at the BLACK SEA and rises gently for about 50 miles until it reaches the altitude of about 3,000 ft. It maintains this altitude as it extends to the west for from 350 to 400 miles dividing BULGARIA into two sections. The mountains then turn nearly north and south for 100 miles, forming the border between BULGARIA and YUGOSLAVIA and being bounded on the west by the valleys of the MORAVA and VARDAR RIVERS. At the IRON GATES of the DANUBE they meet the TRANSYLVANIAN ALPS.

The BALKANS are divided into three sections by the gorge of the ISKER RIVER, which forms a pass from SOFIA, BULGARIA, to the Danubian plain, on the west, and by the DENIR KAPU PASS on the east. The center section is narrowest being about 18 miles wide and the highest having altitudes of nearly 8,000 ft. Maximum

elevations in the western portion are around 5,000 ft. and in the eastern section are less. The western portion is characterized by gorges, steep slopes, rounded uplands, and high passes. All the three sections consist largely of granite and schists.

In appearance the BALKAN MOUNTAINS resemble an upland, rather than a mountain range due to the heavily wooded, rounded ridges. On the northern edge there is a gradual slope to the Danubian plain while on the south the lowlands are separated from the mountains by high and steep escarpments.

The BALKAN RANGE is less of a geographic barrier than its altitudes would indicate being crossed by some thirty passes of varying degrees of usefulness. The majority of these passes have steeply rugged terrain on either side of them for some distance.

The north-south passes are mostly low, the most important being SHIPKA PASS at 4,377 ft. Others are the TROYAN and ROSALITA passes at elevations of between 4,000 ft and 5,000 ft. SHIPKA PASS follows the main road from SISTOVA across the BALKANS near the village of SHIPKA. The pass is not a gap since the road does not pass between high peaks but crosses the ridge at the highest point. Near the summit of the pass, running parallel and close to the road, are three ridges about 200 ft high and 2 miles from north to south, which could form excellent defensive positions for a force attempting to hold the pass.

There are several passes to the east and west through that part of the range running north and south and bordering BULGARIA and YUGOSLAVIA. The most famous, although perhaps not the most important, is the IRON GATE between ROMANIA and YUGOSLAVIA through which the DANUBE RIVER flows. This is a narrow gorge-like pass which is so constricted as to be a handicap. The railroad between the two countries uses another pass to the north.

The main gap between BULGARIA and YUGOSLAVIA is the DRAGOMAN PASS at the headwaters of the MORAVA RIVER and the MARITZA RIVER between SOFIA and NIS, YUGOSLAVIA.

Further south there are three more gaps east and west through the very rugged terrain. The first, through which a railroad line passes, extends from KUSTENDIL, BULGARIA, to SKOPLJE, YUGOSLAVIA; the terrain in the vicinity of this gap is almost impossible to negotiate if properly defended.³ Next to the south, a pass extends across the mountains from CAREVO-SELO, BULGARIA, at the headwaters of the BREGNALITZA, RIVER. The last gap is the valley of the STRUMITZA RIVER just north of the Greek frontier. It must not be assumed that these are the only negotiable passes; as has been stated there are some thirty through the BALKAN MOUNTAINS at varying degrees of negotiability.

The Transylvanian Alps. Separated from the BALKAN RANGE by the IRON GATE, the TRANSYLVANIAN ALPS run north and east until they blend with the eastern end of the CARPATHIAN RANGE. The name, TRANSYLVANIAN ALPS, was given to what is essentially the southern

portion of the CARPATHIANS because the relief of this part of the range so closely resembles that of the ALPS in its ruggedness.

The relief generally is quite complex, consisting of high elevations cut through by rivers, of broad plateaus, and of rocky crags. The southern edge is quite steep being formed of primitive rock, while the northern edge that slopes into TRANSYLVANIA and HUNGARY is not as difficult. The southern edge is fairly heavily wooded.

The TRANSYLVANIAN ALPS reaches an average altitude of between 7,000 and 8,000 ft., with the highest peak being MT. NEGOI, at 8,345 ft.

The mountain slopes are covered with forests of pine, oak, beech, chestnut, and fir, some of these being found up to the 5,000 ft level. Above 6,000 ft there is no vegetable life beyond a few lichens, the peaks being steep, rocky, and bare. Sometimes the peaks take a conical shape. There are no glaciers or perennial snowfields in these mountains.

Passes through the TRANSYLVANIAN ALPS are numerous; however, they generally pass through steep winding ravines, and only ten can be considered as having any military value.⁴ Some of the passes are: one, from ORSOVA to TEMESWAR through ~~TE~~ECOVA through which a railroad runs; second, the TURNU ROSU pass through the gorge formed by the ALUTA RIVER, and, last, the BOGDA PASS. There is no information on the military value of these passes, but the German Army used them in its campaign against RUMANIA in World War I.

The Carpathian Mountains. This range extends for 800 miles in the form of a great semi-circle from BRATISLAVA in CZECHOSLOVAKIA to ORSOVA in ROMANIA, and includes the TRANSYLVANIAN-ALPS discussed above. The CARPATHIANS are a rugged chain with altitudes of 7,000 to 8,000 ft, but they are not a difficult mountain barrier.⁵

The mountains have the appearance of a very broken mass in which numerous detached blocks are separated by wide and shallow basins. Much of the description used in discussing the TRANSYLVANIAN ALPS could be applied to the CARPATHIAN RANGE, although the relief of the latter is less intensely rugged than that of the former.

The outer belt of the CARPATHIANS is known as the BESKID MOUNTAINS and is composed of sandstones and shales known as CARPATHIAN sandstones. The surface of this belt is dotted with settlements and cultivated tracts, but from it arise parallel ridges of resistant rock whose steep ridges are heavily wooded.

The inner belt has an extremely complicated structure of dissected massifs of varying heights alternating with broad, terraced depressions having a general east-west trend. There is evidence of severe glaciation in this inner belt.

The breadth of this range is considerable, reaching its greatest width between the BANAT and TRANSYLVANIA, a distance of from 240 to 250 miles; however at the middle of the arc, in the CARPATHO-UKRAINE area, there is a marked decrease in height

and width (from an average of 180 miles wide to 60 miles). Here a number of easy passes connect the headwaters of the TISZA and DNEISTER RIVERS.

In the western CARPATHIANS is located the TATRA group which includes the highest elevation in the entire range, GERLSDORFF PEAK with an altitude of 8,737 ft.

The passes through the CARPATHIANS, both in a north-south and a east-west direction, are numerous and have been used since the earliest times as routes of commerce and war. The ten passes spoken of above in the discussion of the TRANSYLVANIAN ALPS as being the only ones of military value include all the passes in the CARPATHIAN system that come in this category. Between HUNGARY and the northern foothills of the mountains, which is a lowland plain stretching into USSR and POLAND, are a number of fairly easy crossings, the most important being the MORAVIAN GATE. It can be safely assumed that some of these are included in the ten mentioned above.

While the CARPATHIAN RANGE is not a difficult barrier, it is certainly the last effective mountain obstacle between HUNGARY and ROMANIA and the steppes of the UKRAINE.

Major Rivers

The many rivers, large and small, which cut up the BALKAN PENINSULA present a maze of serious obstacles to the passage of large armored forces. The most striking fact concerning these streams is

that twice a year there are periods of great flood, once in early spring when the snows melt and again in the summer during the time of the summer rains. In many instances these floods cover vast areas creating marshes and swampy ponds which remain long after the floods have subsided.

The Danube River. This great river meanders across CENTRAL EUROPE from the GERMAN BLACK FOREST through portions of AUSTRIA, GERMANY, HUNGARY, YUGOSLAVIA, BULGARIA, and ROMANIA to reach the BLACK SEA, a distance of approximately 1,875 miles. It first enters the area under study on the western borders of HUNGARY and flows through that country and YUGOSLAVIA to the IRON GATE in the BALKAN MOUNTAINS; this area is sometimes called the third basin of the DANUBE.

This third basin is composed of a vast flat plain without undulations of any kind. It is intersected by large rivers with marshy banks which empty into the DANUBE, and it is interspersed with marshy pools. The marshes cover an area of about 3,053 square miles. From BUDAPEST to BELGRADE the river flows through a plain covered with alluvium through which it frequently cuts new channels and fills up old ones.

Passing through the IRON GATE, the DANUBE enters ROMANIA where it widens from 1,400 ft to 2400 ft. In some places it resembles a lake studded with islands. For a distance of 270 miles from the IRON GATE the river forms the border between BULGARIA and ROMANIA.

The border portion of the river is a formidable obstacle⁶ to north-south movement from the IRON GATE to the BLACK SEA. The northern (Romanian) bank is formed of flat plains and broad swamps while the southern (Bulgarian) bank is a wall of loess and limestone about 500 ft. high forming a bluff along the river. The Romanian bank is commanded throughout its length by the Bulgarian bank.

The DANUBE floods in April and in June reaches 20 to 27 ft. above low water. During this flood a great lake is formed on the Romanian side of the river. In late summer and early autumn the stream is at its lowest.

Varying extremes of climate affect the river, and for two or three months out of the year it is frozen over. The freezing occurs about 77 winters out of 100.

The majority of the BALKAN rivers flow into the DANUBE, and it is estimated that it drains a total of about 300,000 square miles.

The Tisza River. This river is the largest tributary of the DANUBE. It rises in the northeastern CARPATHIANS at a height of about 6,300 ft. where it is formed by the junction of many mountain streams. It follows a winding route for about 870 miles across HUNGARY into YUGOSLAVIA before it joins the DANUBE about 50 miles northwest of BELGRADE.

Two periods of flood occur on the lower and middle river. The first takes place in early spring and is a result of the thaw; the second comes in June after the summer rain.

The spring flood coincides with the flood of the DANUBE, and since the DANUBE's flow is quicker, it backs up the TISZA and causes extensive flooding as far as SZOLNOK in HUNGARY, a distance of 197 miles. During these floods great damage is caused to cities and towns along the river.

The Sava River. The SAVA RIVER is a natural barrier of great defensive strength.⁷ It is a large unfordable stream that follows a circuitous route for 540 miles from the eastern slope of the JULIAN ALPS southeast across YUGOSLAVIA to its confluence with the DANUBE at BELGRADE.

The upper part of the river flows through a narrow valley enclosed by mountains while the lower part passes through fairly flat plains. West of BELGRADE the plain is broad and marshy, and, west of the KOLUBARA RIVER a few miles from BELGRADE, there are extensive swamp lands on either side of the stream which are difficult to cross at any time. During the spring and autumn these swamp areas are covered by flood waters which render them impassable.

The SAVA is navigable throughout the major portion of its length—from LJUBLJANA to BELGRADE.

The Drava River. This stream is one of the principle right bank tributaries of the DANUBE. It rises in the TIROL and flows for 450 miles in a southeasterly direction across YUGOSLAVIA to the DANUBE, which it joins 14 miles east of OSIJEK. At its mouth it is 1,055 feet wide and 20 ft deep. River steamers can navigate the river up to 95 miles from its mouth.

The Maritza River. The MARITZA RIVER is a large stream, about 300 miles long, which rises in the wooded northern foothills of the RHODOPE MOUNTAINS. As it flows down the slopes, it is a turbulent mountain stream, but after leaving the hills its gradient is slight, and it winds along between low banks. Its southern tributaries have a relatively even flow while its northern ones are almost dry in summer becoming raging torrents after melting snows or the rains.

The middle MARITZA, with its bed of shingle or pebble, is a considerable obstacle due to the marshes and rice fields which line its banks. Numerous islands, some of which are merely sand banks while others are tree covered and permanent, characterize this part of the stream.

Below PLOVDIV, BULGARIA the river is over 200 yards wide, is three to six ft deep, and has a slight current except in time of flood. Below BORISOVGRAD the river flows in a plain a mile wide between bluffs which in a few places form almost a gorge.

The MARITZA is navigable from its mouth to ADRIANOPLE, a distance of about 100 miles.

The Dneister River. This river rises in the northern slopes of the CARPATHIANS in POLAND and forms part of the old boundary between USSR and ROMANIA. It is the last water obstacle between the BALKAN countries and the steppes of the UKRAINE.

The course of the river is generally winding to the southwest, and it has an average rate of flow of approximately 1 7/11 miles per hour. The average width of the channel is from 500 to

700 ft. going as high in some places as 1,400 ft. As it enters the BLACK SEA, a few miles southwest of ODESSA, it forms a broad estuary.

The DNEISTER has two flood periods. The first is during the latter part of February and the first part of March when the ice breaks up; this is the larger of the two floods. The second takes place in June when the snow melts in the CARPATHIANS. This flood raises the depth of the water about 20 ft. and towards the mouth of the river submerges the gardens and vineyards along its bank.

As of 1928 there were no bridges over the river between the USSR and ROMANIA due to poor diplomatic relations;⁸ it can safely be assumed that this condition has been rectified by the Russians since the annexation of BESSARABIA.

The Prut River. The PRUT rises on the eastern side of the CARPATHIANS and flows circuitously south and southwest between BESSARABIA in the USSR and MOLDAVIA, in ROMANIA, to its junction with the DANUBE about 12 miles below GALATI. The length of the river is about 500 miles. It is navigable for about 200 miles. For 40 or 50 miles north of its confluence with the DANUBE the PRUT has extensive marshes along its bank.

The Morava River. This stream flows generally north from near SKOPLJE, YUGOSLAVIA, where it rises, to the DANUBE about 30 miles east of BELGRADE. It is about 250 miles long and is navigable for about 50 miles from its mouth.

The valley of the MORAVA forms a part of two of the most famous pathways north into the heart of the BALKAN countries from the southern tip of the peninsula.

The Struma River. This river rises in the central depression region of BULGARIA. It flows through the RHODOPE MOUNTAINS in a narrow valley which in several places becomes a gorge. Where it passes through basins, its banks are commonly marshy and its bottom sandy or muddy. During flood, the stream changes its course across the basins and leaves behind extensive areas of gravel.

The STRUMA is generally 30 to 50 yards wide and rarely over 4 ft. deep. Its tributaries in the RHODOPES, except for the STRUMITZA, are insignificant torrents but may become impressive obstacles in time of flood which is usually in the spring following the melting snows.

Other rivers in the BALKAN area about which little or no definite information could be obtained but which exhibit all the characteristics of Balkan rivers as to floods, narrowness, rapidity, etc. and must be considered are: the VARDAR in GREECE, and the MURESUL, OLTUL, DAMBOVITA, and SERETH in ROMANIA.

General Terrain Considerations

Greece - The terrain of GREECE is unfavorable for large scale military operations,⁹ although it was demonstrated by the German Army in 1941 that a well organized, modern land force could readily operate in the country against any but the most thoroughly prepared opposition.

Most of GREECE is mountainous with small, scattered intermontane valleys interspersed among the highlands and connected by passes and defiles; about one-half the country lies above 1,500 ft. Movement is necessarily channelized along established routes.

The PINDUS, RHODOPE, and other mountains that go to make up the greatest portion of the relief of GREECE have already been discussed in the earlier part of the chapter and will not be covered again here. The largest lowland area of the country extends from the basin of FLORINA in the west to the plain of SALONIKA through a narrow corridor, and over a series of hills and plains in THRACE to the MARITZA RIVER, forming the Greek-Turkish boundary. Other lowlands are centered around LARISA and ATHENS. The rest of GREECE is difficult to cross with mechanized equipment due to the numerous rounded, rocky hills which characterize the terrain.

Few of the rivers of GREECE have perennial flow--the MARITZA, NESTOS, STRUMA, and VARDAR being the four major streams that have year round flow. In the summer most of the Grecian streams are fairly easy to cross, but during the rainy season (March to May) they may prove difficult to negotiate, being largely unbridged.¹⁰ The valleys of the four major rivers offer routes into the interior of the BALKAN PENINSULA, but the streams are obstacles to east-west movement.¹¹ In the portions of the lowlands that are unsettled are marshes which are nontrafficable at all seasons.

The soils of GREECE are mostly of the mountain type, however, in the lowlands there is a fine-textured alluvium.

Approximately one-fifth of the country is under cultivation. The cultivated area, subdivided into small plots, is located in the valleys and basins and offers little concealment. Large forests do not exist to any extent; the forests that do exist are located largely in terrain that is eminently unsuited to military movement, namely, the mountains. Trees in the remainder of the country are the Mediterranean scrub type, the olive being a good example.

Albania--The significant fact about ALBANIA is its inaccessibility, the high mountains of the DINARIC ALPS and the PINDUS RANGE effectively isolating the country by land.

Topographically ALBANIA can be divided into two clearly marked regions, a western portion from the Yugoslav border to VALONA and inland as far as a line SCUTARI-TIRANA-VALONA, and an eastern portion, including that part of the coast around VALONA.

The western portion of the country is a plain area that generally does not rise over 600 ft. The surface of the plain is not uniform but is broken up by small ridges which rise to about 1,000 ft. and extend generally northeast and southwest.

The soil in western ALBANIA is lateritic, being composed of a deeply weathered, brown surface soil covering a deep red intermediate layer and mottled subsoil. The internal and external drainage of this type soil is good and flotation is good except immediately after heavy rains, however, this portion of the country contains much marsh and undrained land.

The eastern portion of ALBANIA and the coastal lands south of VALONA are mountainous with peaks rising to 9,000 ft. in the north and 7,000 ft. in the south. There are some lowlands within this mountain region, but these flatlands are subject to flood.

The soil of this eastern area is of the mountains and mountain valleys; this is a dark brown surface soil covering and a streaked or mottled grayish and rust subsoil. It supports grasses, sedges, and flowering plants and has good flotation characteristics except in stream beds.

The vegetation of ALBANIA is mainly of the Mediterranean scrub forest type which offers little in the way of concealment.

Yugoslavia. YUGOSLAVIA is a country of rugged relief, being flanked on two sides by mountains and having a high central axis and precipitous coastline. The only extensive lowland area, the PANNONIAN PLAIN, is in the north central portion of the country, and the remaining two thirds is a mountainous section cut up by fertile valleys. The general appearance of this latter area is, in fact, very similar to that of KENTUCKY.¹²

The PANNONIAN PLAIN is a wedge-shaped, southeastward extension of the HUNGARIAN PLAIN and rises gradually into the Slovenian and central Yugoslav mountains in the south. Here is located most of the nation's agricultural potential as well as many important cities and industrial centers. It is the only large area in YUGOSLAVIA that affords real facility of movement for large bodies of troops.

Paralleling the coast are the DINARIC ALPS, and along the Greek border the PINDUS MOUNTAINS act as a barrier between the two countries. The Bulgarian frontier is formed by the VARDAR RIVER and the BALKAN MOUNTAINS, and the border with ROMANIA is mountainous in its southeastern corner. From the standpoint of relief, therefore, YUGOSLAVIA is difficult to enter or leave on all sides except the north into HUNGARY.

YUGOSLAVIA is covered by three general types of soil. A 50-75 mile strip along the southern border of the country is comprised of lateritic soils; the DINARIC ALPS area has soil of the mountain and mountain valleys. The remainder of the country is generally grey-brown podzolic soil.

This latter type of soil has a grayish brown topsoil covering intermediate layers of brown, blanketed at the surface with a thin layer of dark colored organic matter. The soil supports deciduous and coniferous forests. The flotation capability is good, except after heavy rains when valley floors and places where sodimentation has occurred become very miry. Drainage is extremely good, however, and the soil becomes trafficable a few hours after the rains cease.

The main rivers of YUGOSLAVIA are the DRAVA, the SAVA, and the DANUBE, all of which flow eastward along the PANNONIAN PLAIN. A few small rivers flow into the ADRIATIC, but none is really important. The VARDAR is the only river that flows south into GREECE which is of any importance. Serious spring floods occur in the Yugoslav streams,

and the coastal mountains streams after being practically dry during the late summer and winter become swift torrents as the snow melts. The only important water obstacles are the DANUBE, SAVA, DRAVA, and TISZA RIVERS, except during spring floods. In the southern and western parts of the country the rugged terrain through which the streams flow presents more of an obstacle to movement than do the streams themselves.

The vegetation of YUGOSLAVIA consists of coniferous forests, deciduous and mixed forest, Mediterranean scrub, and steppe. Over 30% of the country is covered by forests, which are mainly located in the highland areas or in areas of difficult cross-country movement. Throughout this belt there is little land in cultivation, and opportunity for concealment is excellent.

In the southern part of the country, near the Greek frontier, vegetation is sparse with large areas of dwarfed Alpino growth. Concealment is poor here except in scattered mountain valleys.

Along the coast the vegetation is of low scrub type which offers little concealment, and, in some areas, impenetrable thorny plants and vines present serious obstacles to foot movement.

On the PANNONIAN PLAIN, where more than 75% of the land is under cultivation, steppe-type vegetation is found. Except in fringes of poplar and willow along streams and in scattered wooded areas, very little natural concealment is to be found here; however in spring and summer grain fields offer limited concealment.

Hungary. HUNGARY is generally flat, averaging 330 ft. above sea level. It occupies the flat portion of the Alpine depression and is surrounded by the CARPATHIAN, ALPS, and the DINARIC system. None of these mountains, however, extend into the country except in the north where the southern portions of the SLOVAKIAN CARPATHIANS cross the border.

The only highlands in the country are the MATRA MOUNTAINS and the BAKONY FOREST which are in reality mountainous hills with heights of 3,330 and 2,281 ft. respectively. The BAKONY FOREST is about 55 miles long and 25 miles wide and is an extension of the ALPS. It reaches across western HUNGARY from the ALPS past LAKE BALATON to a juncture with the SLOVAKIAN CARPATHIANS north of BUDAPEST.

The BAKONY FOREST divides HUNGARY into two unequal sections: the LITTLE HUNGARIAN PLAIN in the northwest and the GREAT HUNGARIAN PLAIN or ALFOLD in the east. The soil of both these sections is an alluvial gray-brown podzolic type.

The two most important rivers in the country are the DANUBE and the TISZA. Many minor streams meander across the extremely flat plain and feed either into the TISZA, the DANUBE, or LAKE BALATON which alone has more than 30 streams draining into it. Often the many rivers and streams are bordered by swamps and marshes. LAKE BALATON, which lies 55 miles southwest of BUDAPEST, is the largest lake in HUNGARY being some 47 miles long and 7 to 9 miles broad with a depth of 15 to 40 ft. Minor steamer traffic is carried on the lake.

The greater portion of the natural vegetation covering the Hungarian plain is prairie grass or steppes; however, a great portion of the land is given over to cultivation. Approximately 40% of the country is devoted to cereals, wheat, rye, and corn while about 26% is pasturage, hay, forage, etc. This type of vegetation would offer very little concealment of any kind. The forested area is very small; only some 12% of the total land area being given over to woods. The majority of this land is in the hilly areas; consequently, the BAKONY FOREST and the MATRA MOUNTAINS offer the only large areas where concealment may be had.

Bulgaria. BULGARIA is a land of moderately rugged mountains, lowland and highland basins, low plateaus, and a close network of streams which in the basins are commonly bordered by swamps. The major mountain features trend east-west and form major corridors; while the minor features, such as passes and valleys trend roughly north-south and form more constricted corridors. The streams are extremely irregular in flow and during drought are commonly fordable except in their lower courses. Most of the southern portion of the country is drained into the AEGEAN by the STRUMA, MESTA, and MARITZA systems while the northern portion is drained into the BLACK SEA through the DANUBE system.

BULGARIA is conveniently divided into four east-west belts or regions; the SOUTHERN HIGHLAND REGION, the CENTRAL DEPRESSION, the BALKAN MOUNTAINS, and the DANUBIAN TABLELANDS, taken from south to north. They will be considered here in that order.

The SOUTHERN HIGHLAND REGION is the southernmost belt and extends from the southwestern border to the BLACK SEA. The ranges of these mountains, the RHODOPES, trend east-southeast and are characterized by gorges, steep slopes, rounded uplands, and high passes; as they pass to the east they become lower and less rugged.

The northern edge of these mountains is drained by the MARITZA which cuts a shallow gorge across them near EDIRNE. The southern edge is drained by the STRUMA and MESTA RIVERS and the tributaries of the lower MARITZA. The streams which rise in the mountains are torrents whose flow is greatly affected by the rains and melting snows of spring, the drought of late summer, and the autumn rains.

The STRUMA RIVER has already been discussed under GREECE.

The MESTA RIVER rises in the RILA PLAIN and flows for the most part through long gorges and small basins. At NEVROKOP it passes through an extensive basin and again enters a gorge. Roads usually avoid the river because of the extremely steep banks. The stream is generally 50 to 65 yards wide, 6 feet deep, and has a current of four to five miles per hour. In the summer the stream can be forded in many places on foot.

The northern part of the CENTRAL RHODOPE is drained to a large extent by streams which flow northward into the MARITZA. These streams flow through narrow, wooded valleys and are less torrential than the south flowing streams. Their swift waters and deep sides make them difficult to cross in most places.

The soil of the SOUTHERN HIGHLAND SECTION of BULGARIA is mostly lateritic with good internal and external drainage and fairly good flotation except after heavy rains.

North of the SOUTHERN HIGHLANDS is the CENTRAL DEPRESSION REGION of BULGARIA. It is a series of basins of varied sizes and altitudes, and, east of SOFIA, it is almost pinched by the BALKAN MOUNTAINS and the RHODOPES into two sections, high upland basins to the west and low basins to the east.

This area is drained largely by the MARITZA systems. Its higher western end, however, is the divide between the ISKER and the STRUMA Rivers, and its eastern end drains directly into the BLACK SEA. In general, its streams are mountain torrents near their headwaters, but in the basins, where their course is winding, they may flood the adjacent countrysides.

The upper ISKER rises as a cluster of mountain torrents on the north slope of the RILA PLAINA. It cuts through several gorges before spreading out over the flat center of the SOFIA basin. Here it is joined by tributaries which come together in the marshy area north of SOFIA. From the capital city the stream flows north across the BALKAN MOUNTAINS through a deep winding gorge which provides the pass from the DANUBE basin to SOFIA. Generally, the ISKER is shallow, but its alternating gorges and obstacles make it a considerable barrier.¹³

The MARITZA RIVER has already been discussed above.

The TUNDZHA RIVER is fairly typical of the northern tributaries of the MARITZA. It begins as a narrow mountain torrent in the SUB-BALKAN BASIN and, after turning south near YAMBOL, has a width of 35 to 50 yards and a depth of from three to seven feet. The depth increases to 10 to 15 feet during the spring floods, but during summer drought the gravelly bottom can be crossed by carts in many places. Near its junction with the MARITZA the river cuts through a narrow gorge for several miles.

North of the CENTRAL DEPRESSION rise the rounded ridges of the BALKAN MOUNTAINS; since the topography of this range has been discussed previously, only the drainage system will be discussed here.

The drainage of the Balkans consists mostly of the headwaters of streams which are described in detail under different regions. In general, the southward flowing streams are mountain torrents which flow in gulleys or canyons only after thaws or rains on the mountains. The northward flowing streams are perennial and converge to feed the streams of the DANUBE plateau. In the EASTERN BALKANS the perennial southern branch of the KAMCHIYA rises in the center of the mountains. This river flows through a tortuous and, in places, constricted valley as it cuts across the northern edge of the BALKANS.

The BALKAN MOUNTAINS descend gradually to the DANUBIAN TABLELANDS, partly a plateau and partly a hilly area, which extend northward and eastward to end abruptly in cliffs along the DANUBE

RIVER and the BLACK SEA.

The rivers which cross the plateau are fed by streams, usually torrents, rising on the plateau and streams, rising in the BALKANS, usually perennial. In most cases the streams are winding and entrenched and become more deeply entrenched downstream. The east banks are normally high and steep and under-cut while the west banks are usually low and flat and bordered by marshy sediments. Most of the streams flood in May and at that time change their courses and form new channels and islands. The principle rivers of the region are described below from west to east.

The LOM RIVER rises in the WESTERN BALKANS and descends rapidly northeastward. Upon reaching the plateau it turns eastward and flows through a wide marshy valley. It is usually fordable.

The OGSTA RIVER rises near BERKOVITSA. In its headwaters it is a torrent, but downstream it flows into an open valley 2 to 2½ miles wide. The stream is very shallow.

The UPPER ISKER RIVER has already been discussed; however, the lower river has a depth of 5 to 6½ feet and is fordable only at KARLUKOVO, CHUMAKOUTSI, KOINARE, and MAKHLATA.

The VIT RIVER winds through a steep sided narrow valley to GLOZHERE; thereafter its course alternates between narrow marshy valleys and constrictions. It is fordable in many places and almost everywhere by horse mounted troops.¹⁴

The OSMA RIVER is an extremely tortuous stream which flows northward, cutting across numerous ridges of east-west trending hills.

Near LOVECH the stream winds through a narrow defile and then turns northeast. Its course to the DANUBE is a great bend northeast then northwest through a marshy, two mile wide valley overlooked on the east by cliffs. The stream is too deep for fording and represents a considerable military obstacle.¹⁵

The YANTRA rises near SHIPKA PASS, then flows through narrow valley to TARNOVA north of which it cuts through a defile. Beyond this it enters a wide valley into which flow tributaries with wide valleys from the east and west. The YANTRA VALLEY is moderately wide and well drained to BELA, north of which it is low and subject to flooding. The lower river is 55 to 75 yards wide and 6 to 13 foot deep. Everywhere below TARNOVO it is a good defensive line.¹⁶

The BANISKI LOM RIVER is formed by several winding streams flowing in narrow valleys. These streams are adjoined by limestone cliffs and therefore afford better defensive lines than their shallow depths would suggest.

The KAMCHIA and PROVADISKA rivers meander eastward to the BLACK SEA through marshy troughs, one to two miles wide. The adjacent hills are not generally steep, and the marshes are discontinuous, hence these valleys afford only moderately strong defense lines.¹⁷

With the exception of the SOUTHERN HIGHLAND, BULGARIA is covered with gray-brown podzolic soils; these soils have excellent drainage and within a few hours after rain should offer good going.

Romania. Physically ROMANIA presents two definite aspects: the CARPATHIAN or HIGHLAND REGIONS, rugged, damp, and thickly wooded, and the DANUBIAN or LOWLANDS, flat or slightly undulating, low (only 700 feet or less above sea level) and arid.

The main topographical feature of the Highlands is the CARPATHIAN MOUNTAINS which make a great curve through the heart of ROMANIA. Inside the curve lies the TRANSYLVANIAN BASIN which, like the HUNGARIAN plain (ALFOLD), is an old sea basin filled with river deposits. Unlike the ALFOLD, however, TRANSYLVANIA has been uplifted and cut up by running water so that it is high and hilly. Blocking the western side of the basin and separating it from the Hungarian plain are the BIHAI MOUNTAINS, a complex and rugged area.

Two fairly large rivers drain the TRANSYLVANIAN BASIN proper; they are the MURESUL and the SOMESUL. Both flow generally west forming an obstacle to north-south operations and empty into the TISZA RIVER in HUNGARY.

The heavily forested mountain areas make up approximately 25% of the land area of ROMANIA, but within the Basin much of the land is under cultivation.

The area between the CARPATHIAN and BALKAN MOUNTAINS resembles the plains of the PO in NORTHERN ITALY in that it was the gulf of a sea and has been entirely filled up by river deposits. The northern portion is cut up into a hilly piedmont. The plain itself lies 150 feet above sea level, and The DANUBE and its many branches, the JIU, OLTUL, VEDEA, ARGIS, DAMBOVITA, and IALOMITA rivers, occupy broad

valleys cut below the general level. The tributaries flowing generally south from the TRANSYLVANIAN ALPS are important obstacles to east-west movement.

South of the mouth of the DANUBE lies the DOBRUJA. In its northern portion it presents a pleasant and not very high mountain system while in the south it is a monotonous plain having steppe vegetation. The soil is very fertile and mostly alluvial, however, much of the area is desolate because of the general lack of springs and wells.

Further north in the lowlands and on the eastern side of the CARPATHIANS is the MOLDAVIAN plateau. Its rivers, the SERETH and PRUT, flow toward the DANUBE in broad valleys as the plateau slopes to the south.

In the extreme northwestern corner of the MOLDAVIAN PLATEAU is the small province of BUKOVINA, a hilly area made up principally of the foothills of the northern CARPATHIANS. Approximately 43% of its area is covered with heavy woods.

The majority of ROMANIA is covered with alluvial and gray-brown podzolic soils; the natural vegetation in the lowlands is steppe grass while in the highlands grass and coniferous and deciduous forests cover the hills.

NOTES FOR CHAPTER 3

¹ SID Report, Greece, (Washington: Intelligence Division, Dept of the Army, 1948), p 3.

² Ibid, p 3.

³ The Balkan Campaign, 1940-1941, (West Point, N.Y., US Military Academy, 1948), p 13.

⁴ McEntee, Col. Girard Lindsey, Military History of the World War, (Chas Scribner & Sons, New York, 1937) p 310.

⁵ Balkan Theatre Book (Ft Knox, The Armored School).

⁶ Supplemental Material on the First World War, (West Point, N. Y., US Military Academy, 1943) p 78.

⁷ Op Cit, Military History of the World War, p 310.

⁸ Encyclopedia Britannica, Vol 7, p 463.

⁹ Greece, (Washington, Central Intelligence Agency, 1948) p A1.

¹⁰ Ibid, p A2.

¹¹ Ibid, p A2.

¹² Op cit, Military History of the World War, p 129.

¹³ Janis 38, Chapter II (Washington, MLD, WOGS, 1943), p II-9.

¹⁴ Ibid, p II-9.

¹⁵ Ibid, p II-9.

¹⁶ Ibid, p II-9.

¹⁷ Ibid, p II-9.

CHAPTER 4

CLIMATE

Climate is a deciding factor to be considered for military operations in any area. The study area is in the cool-temperate zone, although represented by wide temperature variations. The Russian winters were an obstacle which defied and broke Napoleon's campaign, as well as stopping Hitler's armies. Conversely, freezing of rivers enabled the hardy Russians to conduct major winter operations in World War II, where million man armies advanced as much as 300 miles in 50 to 60 days. Winter winds of near gale force in Southern Russia affects observation and accuracy of supporting weapons. Rains swell the numerous rivers, lakes and marshes in spring and fall and restrict mobility and capability for deep penetrations. This study presents an overall picture of climatic factors as they exist in average conditions over a long period of time.

Definition of Climatic Areas¹³

The types of climate are classed into six major types by areas, combining the temperature and precipitation characteristics. As is normal for most areas of the world, the climatical factors of these areas are governed by their proximity to bodies of water and altitudes. The six areas are: Mediterranean; Humid Continental long summer phase; Humid Continental short summer phase; Middle latitude dry steppe; Middle latitude dry desert; and undifferentiated mountains.

The Mediterranean type climate includes the ADRIATIC SEA belt of about 50 miles wide in YUGOSLOVIA, all of ALBANIA, GREECE, EUROPEAN TURKEY, and a belt about 50 miles wide along Turkey's coast reaching from the BLACK SEA to LEBANON on the MEDITERRANEAN SEA.

This type climate is typified by bountiful sunshine throughout the year. Summers are hot and dry except on the northern coasts of TURKEY where summers are sultry and damp. Winters are rainy and mild. Except for thunderstorms at long intervals, summers are rainless and monotonously hot and sunny. Temperatures may exceed 100 degrees fahrenheit and the summer heat is weakening to endurance. Most streams are at low water stage during summer, except when mountain cloud bursts occur. With the coming of cool weather and autumn rains, the countryside again becomes green and remains so throughout the winter. Cyclonic storms from the west occur, sometimes with disastrous results. Cold dry winds may impede operations by causing personal discomforts. There are wide variations in rainfall from year to year and droughts are a serious menace.

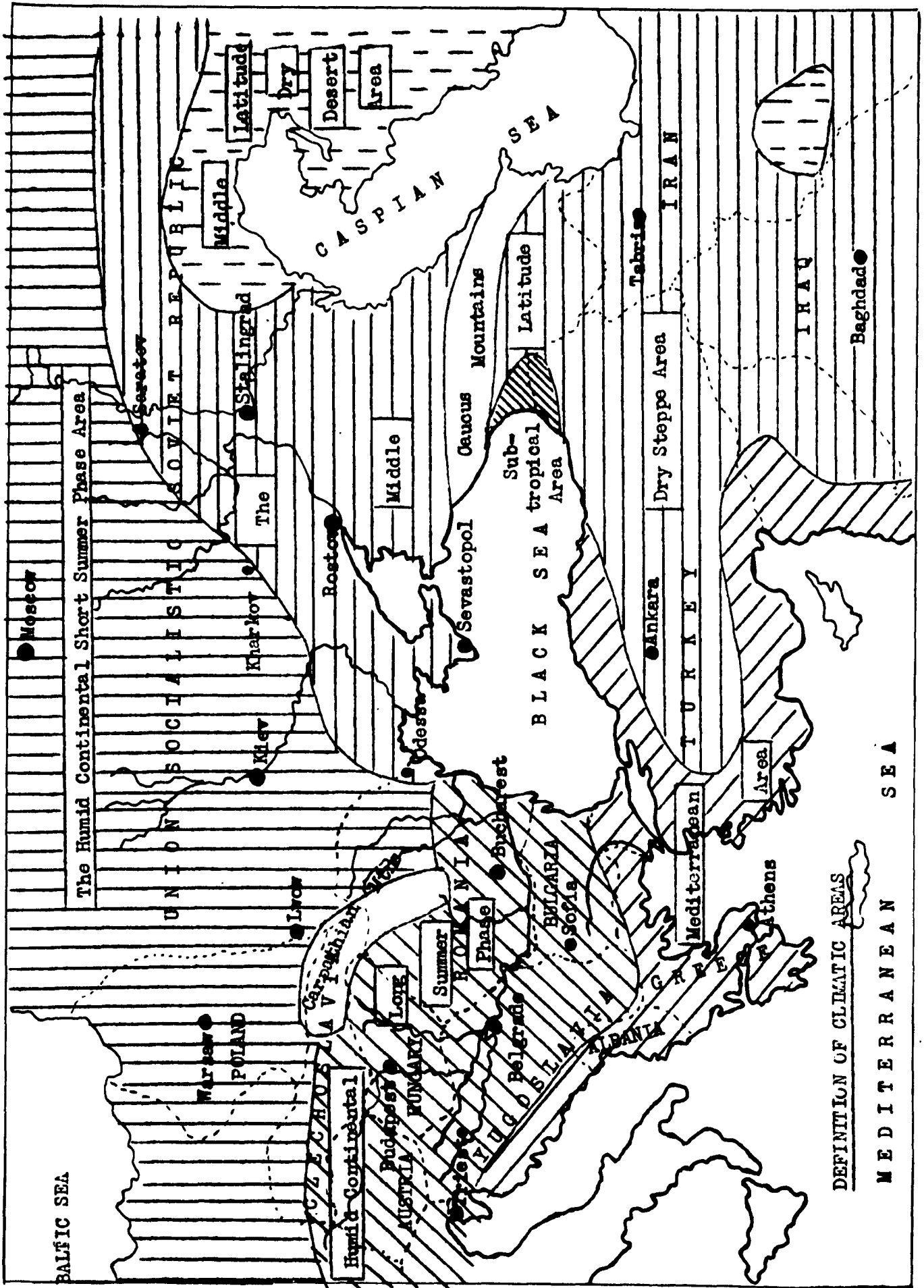
The Humid Continental long summer phase area includes the inland areas of YUGOSLOVIA, all of BULGARIA, HUNGARY, and ROMANIA, except the CARPATHIAN MOUNTAINS. This region is generally characterized by extremes in temperatures and rainfall. The dominating factor of both are mountain areas which are subject to flash floods in summer seasons. Areas nearest the ADRIATIC SEA receive up to 60 inches annual precipitation, mostly rain during

spring and autumn. Although the winter is short, extremely low temperatures are common. Winter freezes are sufficient to stop navigation on the DANUBE RIVER for varying lengths of time each winter.

The Humid Continental short summer phase area is the study area of SOUTH EUROPEAN RUSSIA north of the ODESSA-KHARKOV-SARATOV line. This area is characterized by long winter freezes, and a short summer season. Winter snows present mobility impediments, whereas the frozen soil enhances cross-country mobility in the absence of snow. The short dry summer between the spring thaws and autumn rains is the most opportune season for military operations.

The Middle Latitude Dry Steppe Area includes those areas of RUSSIA south of the ODESSA-KHARKOV-SARATOV line. This area is typified by the lower DNEPR, DON, and VOLGA RIVER valleys, and the high plateau areas of TURKEY. Due to land mass locations, and prevailing winds, two varied areas of different altitudes fall into the same temperature and rainfall classification.

Although the Russian portion of this area has large rivers, and also borders the BLACK SEA, the annual precipitation only averages 10 to 20 inches each year. This is mainly due to prevailing winds from the northwest having deposited their moisture in areas further north. The precipitation is about equally divided between winter snow and rains of spring and autumn. High winds prevailing the year round cause drifting snows in winter and dehydration during the dry summer months.



The Middle Latitude Dry Desert represents low rainfall areas with varied temperatures, varying due to land elevations. These areas include Russian areas bordering the eastern shore of the CASPIAN SEA and high plateaus in IRAN. In both cases summers are extremely hot and dry. Water scarcity and heat exhaustion are serious operational problems. Glare and heat are special problems. The sparse vegetation which exists is parched, as streams dry up during the summer and vision is impaired by mirages. Most of the meager precipitation occurs in winter.

The Undifferentiated Mountain areas include the CAUCASUS and CARPATHIAN MOUNTAINS. Exposure to winds and low temperatures as well as the high altitudes cause an appreciable loss of troop and mechanical energy and efficiency. There is an almost endless variety of local climates in mountain regions. The mountain climates are characterized by lower temperatures than those of the adjacent lowlands, greater and more frequent thunder storms in summer and more snow in winter. In many places more than 100 inches of precipitation falls annually. The ground may be frozen for most of the late fall, winter, and early spring. In the CAUCASUS MOUNTAINS the snow line lies at heights of about 8,000 feet, and variations depend on the annual severity of winter and configuration of the mountain chain itself. Visibility is reduced by frequent and often prolonged precipitation. In summer temperatures are more moderate although protected valleys may be hot. The diurnal temperature variation is great. Frost is possible

at night even in the warmest months. The highest slopes may be snow-covered throughout the year, but most passes and roads are free of snow and ice for a few months.

A Sub-tropical Area at the western base of the CAUCASUS MOUNTAINS on the RUSSO-TURKISH border presents an opposite extreme to the mountain areas. The rainfall averages up to 80 inches each year, and the temperature seldom goes below 60 degrees, being fairly constant throughout the year.

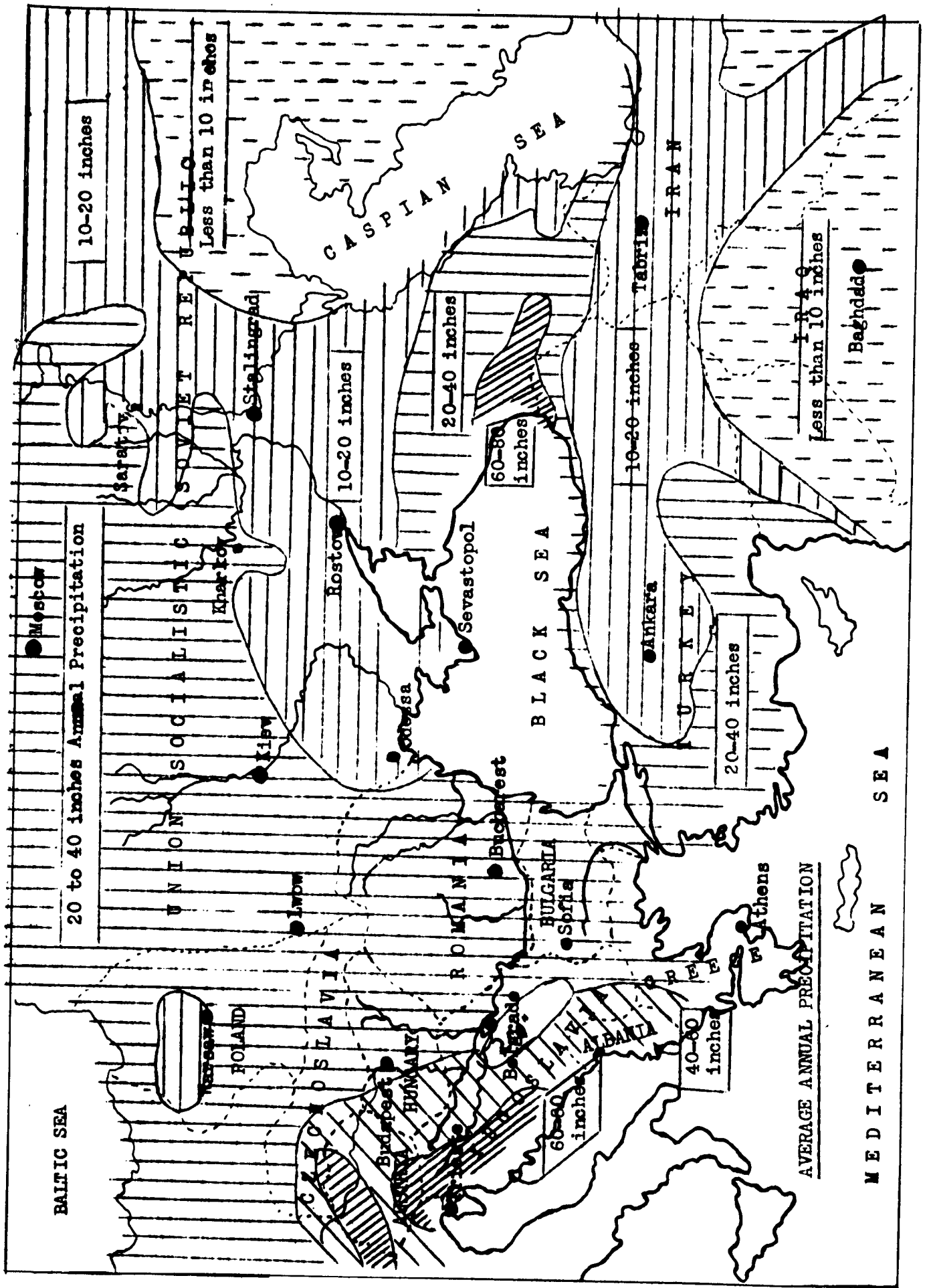
South European Russia^{1, 2, 3}

Russian climate is unique in that it would be of a nature approaching arctic coldness, were it not for the fact that no major mountain barriers exist on Russia's North European borders. As it is, the warm Atlantic Ocean winds, which produce the effervescent continental climate of EUROPE, also sweep as far inland as MOSCOW. This causes most of CENTRAL RUSSIA, from LENINGRAD south to KIEV, to have the continental type climate with temperatures ranging from 14 degrees in winter to an average of 66 degrees Fahrenheit in summer. The winters are quite cold due to the humidity and high winds, often of gale force which lash across the low rolling plains. Winters are characterized by cyclonic storms with frequent changes of weather. Periods of slow rainfall or drizzle may persist for many days. There is also much snowfall, and due to the high humidity and cold winds coming from the Atlantic, great frost penetration exists.

Often the snow may be blown by the severe gales, thus leaving bare ground and deep drifts. Frosts penetrate to depths of three feet or more, and leave the ground hard and favorable for armored maneuver. When the thaw comes in the spring, soil surfaces become a sea of mire and in many places motorized movement is almost impossible from March until May. Annual precipitation varies from 20 to 40 inches in most of the area.

On the border of ROMANIA^{5, 7} the average winter temperature is 33 degrees Fahrenheit and gets progressively colder to the north and northeast, until at the URAL MOUNTAINS it averages 10 degrees. On the east side of the URALS the temperature drops to -15 degrees. This typifies the effect of a mountain barrier as to its effect on temperatures within a short distance. It might be noted that the Russian winters north of an east-west line through LENINGRAD are arctic in nature.

South of the ODESSA-KHARKOV-SARATOV line the dry steppe climate of RUSSIA exists over the broad rolling plains, which is more favorable for armored operations. However, the winter weather was a determining factor in stopping the German Army's offensive at STALINGRAD. The sky is clouded on an annual average of fifty percent of the days. Rainfall is between 10 and 20 inches in most of the region west of the CASPIAN SEA and less than 10 inches east of it. Winter temperatures fall to 15 degrees, and the rivers are frozen less than four months, as compared with five to seven months of freeze in the northern areas. The DNEPR RIVER below DNEPROPETROVSK



is frozen an average of 90 days each year, and the northeast portion of the SEA OF AZOV requires ice breakers for at least 100 days each year. Winds are from the east-northeast in the summer and west-northwest in winter.

The CAUCASUS MOUNTAINS have a mountain type climate, completely separate and distinct from the remainder of RUSSIA. Here, the summers are cool and the winters are extremely cold. Sixty to 80 inches of annual precipitation falls in the WESTERN CAUCASUS and on the higher slopes. In the central region and for 100 miles north and 50 miles south of the main range 20 to 40 inches falls annually. In the eastern area 10 to 20 inches falls and in the BAKU area less than 10 inches annual rainfall is recorded. Heaviest precipitation comes in winter and is mainly in the form of snow. Movement through the extremely narrow passes is practically impossible in winter and very difficult at other times.

Balkan Area

In general the climate of the BALKAN PENINSULA is one of mild winters without much snow, moderate summers, damp air, little sunshine, and with precipitation throughout the year. Moisture is the primary factor influencing ground operations, summer being the best season for ground movement. With the exception of the CARPATHIAN MOUNTAINS, where a mountain type climate exists, ROMANIA, HUNGARY, BULGARIA, and inland YUGOSLOVIA have a continental type climate with a long summer phase in almost all of these

areas. GREECE, ALBANIA, EUROPEAN TURKEY, and a coastal strip of YUGOSLOVIA are in the Mediterranean type climate.

HUNGARY has a climate conducive to agricultural pursuits. In the western one-fourth of HUNGARY there is from 40 to 60 inches of annual precipitation, principally rain, and from 20 to 40 inches in the remainder of the country. Most of the rain falls in May and June. The summers are hot with temperatures in the 80's and winters are mild with an average of about 32 degrees. High summer temperatures and a long autumn creates a favorable operational season. The skies are cloudy about 50 percent of the time.

YUGOSLOVIA has two distinct climatic types, a Mediterranean type on the ADRIATIC SEA coast, the remainder being the same as her neighboring countries. Along the coast 60 to 80 inches of rain falls annually, and temperatures range from a mild 45 degrees in winter to hot summers of 96 degrees. In the eastern areas temperatures range from 32 to 68 degrees, and precipitation is from 40 to 60 inches each year. One exception is in the high mountains of HERCEGOVINA and MONTENEGRO, where as much as 200 inches of precipitation occurs, and temperatures range from 50 degrees in summer to well below freezing in the winter months. Rainfall is heaviest in YUGOSLOVIA during the October to January season. Cloud cover occurs 40 percent of the time.

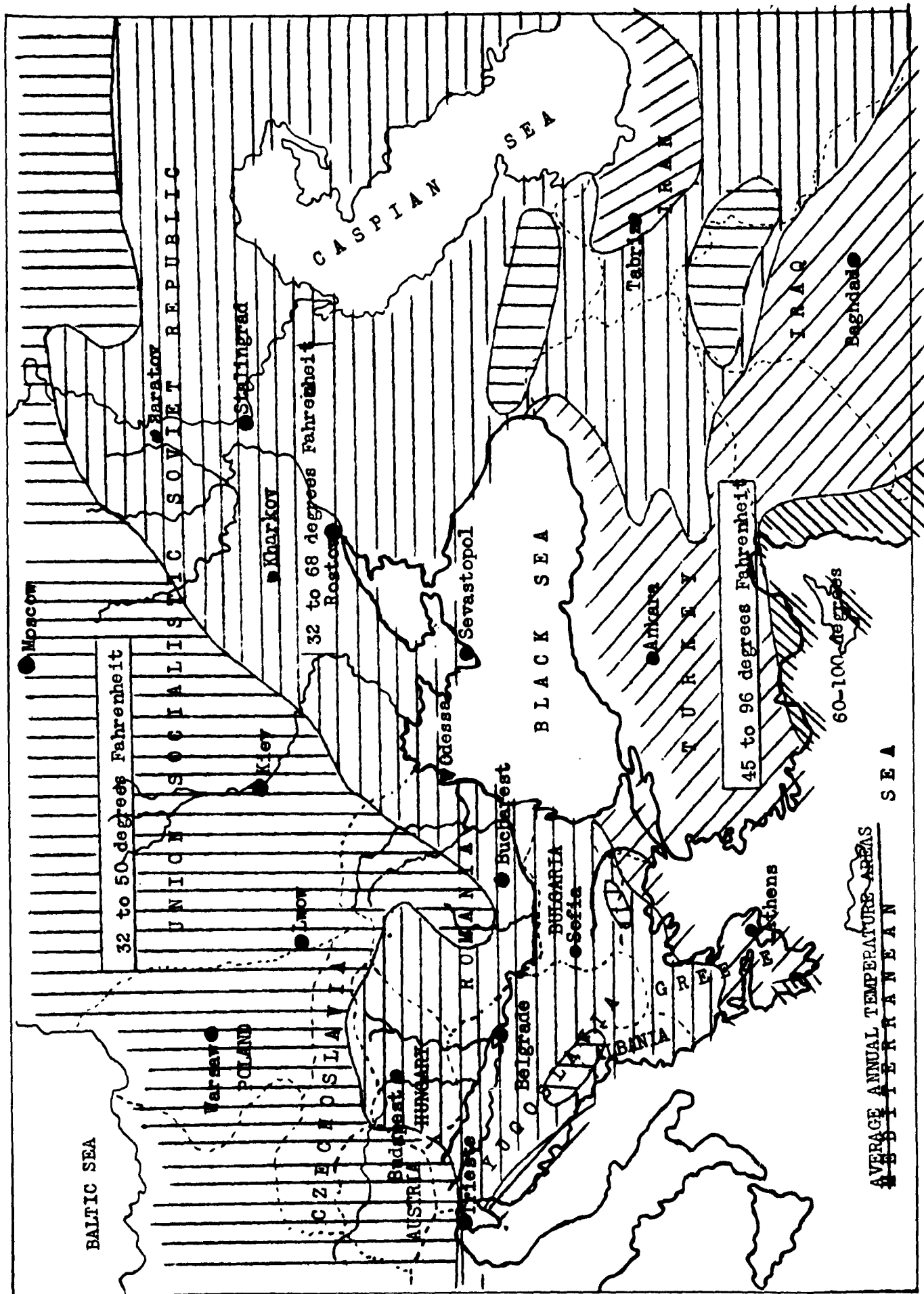
ALBANIA⁴ has a climate similar to the coast of YUGOSLOVIA. Annual precipitation averages 40 to 60 inches, and temperatures range from 32 to 68 degrees the year around.

BULGARIA and ROMANIA^{11, 12} are for the most part identical in nature, having a continental long summer phase climate. Precipitation ranges from 20 to 40 inches, and temperatures vary from 32 to 68 degrees with two exceptions, the CARPATHIAN MOUNTAINS and a small area in the RHODOPE MOUNTAINS of southern BULGARIA. The temperatures in these mountains range from 50 degrees in the summer to 32 degrees and below in winter. The CARPATHIAN MOUNTAINS have a completely mountain type climate, with snow covered summits for about seven months of the year. Rainfall is heaviest during the summer months.

GREECE has a Mediterranean climate with temperatures of 90 degrees in summer and averages of 45 degrees in winter. Precipitation is 20 to 40 inches annually. Extremes occur in the southern province of MOREA, where temperatures range up to 100 degrees and more, and a scant 10 to 20 inches of annual rainfall is common. The northwestern area has a temperature range from 32 to 68 degrees, and has 40 to 60 inches of rainfall each year. Winds are principally from the north in summer and northwest in winter. In the ATHENS area the winds from over the mountains bring cool air which makes the summer more comfortable.

Turkey and Near East

TURKEY'S climate is influenced by two principal factors; the warm nature of the BLACK and MEDITERRANEAN SEAS which bound two-thirds of the nation, and the elevation of the ANATOLIAN



PLATEAU. The latter rises steeply from the coastal plains to come under exposure to dry Mediterranean winds and thus is left with a dry steppe climate of from 10 to 20 inches of rainfall annually. A terrain analysis will show that the primary influencing cause for the close incidence of the precipitation and temperature lines is due to the sharp manner in which the ANATOLIAN PLATEAU rises from the Turkish coastal plains.

Twenty to 40 inches of precipitation fall on the north coastal plain, and 10 to 20 inches on the ANATOLIAN PLATEAU. Western TURKEY has hot summers averaging 74 degrees, and cool winters averaging 43 degrees. The eastern regions have hot summers of 67 degrees and cold winters of 21 degrees. KARS in northeast TURKEY has temperatures ranging from 10 degrees in winter to 64 degrees in summer. Low rainfall, few streams, high elevations, and warm winds blowing from the northeast out of the Russian land mass across the still warmer BLACK SEA make summer operations difficult due to the heat, dust, and lack of water.

The west and southwest coastal areas have a distinct winter rainy season and a dry summer season. Cloudy skies and heavy showers that yield moderate amounts of rainfall are common in November and December, but there are cloudless periods. Snowfall not uncommon along the coast at sea level, however, is not long lasting. Summers are long, very hot, and almost rainless and cloudless. During this season of drought, small streams become dry, vegetation withers, and the soil becomes dusty.

Air operations are rarely hampered, but the best season is from April through October. Sea and weather favor May to September amphibious landing operations.

Inland from the south and west coasts, winters are cold and temperatures are sometimes below freezing for several days at a time. Winter precipitation is usually snow, and is heavy at times. December is the cloudiest month. Fog is most frequent in winter. In the interior, summers are hot and temperatures frequently exceed 100 degrees. Well distributed precipitation averages 15 to 30 inches annually. Maximum rainfall occurs in May or June in short heavy showers which cause destructive floods and muddy grounds, however, rapid evaporation causes the ground to dry quickly.

An unusual area as to climate is the TRABZON-KARS, TURKEY and AKHALTSIKH-POTI Russian triangle, where a sub-tropical climate occurs. This is unique in that to the west of this area lies the Mediterranean climate, to the south a steppe climate and to the north, the CAUCASUS MOUNTAINS, with a definite mountain climate. Furthermore, it lies above the 40th parallel, which also passes through the vicinity of Indianapolis, Indiana, and is far from being a sub-tropical area.

Considering the general aspects of the climate in the study area as it affects armored operations, it appears that the favorable season for best movement is during summer months. When winter comes, the problem of operating in cold weather will be emphasized. In some areas operations will be similar to desert operations.

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NOTES FOR CHAPTER 4

¹Intelligence Review 184, Sept 51-DA, Military Geography of Europe and the USSR, Climate.

²Weekly Intelligence Review 95, Climate of the USSR.

³JANIS 24, Military Geography of the USSR, Climate and Weather.

⁴ONI-116, Balkans, Albania, Climate, General Characteristics, p 39.

⁵The Climates of the Continents, W. G. Kondrow, Weather, winds-pp 232, temperatures and rainfall-pps 254 and 298.

^{*6}Climatology, A. Austin Millor, Cool-temperate climate, pps 199-200; cloudiness, pp 22; and, winds pps 29 and 30.

⁷Weather Around the World, Ivan Ray Tannehill, temperatures pps 79 to 81.

⁸Atlas of World Maps, Hq., Army Service Forces, Climate--Greece, Albania, Yugoslavia, and Bulgaria; temperatures pps 270 and 271.

^{*9}Europe, Valkenburg and Huntington, Climate of Hungary, etc pps 527 and 528.

¹⁰Atlas of the World, Rand-McNally, 1946, Rainfall pps 269 and 270.

¹¹JANIS 38, Chapter II, Climate, Seasonal Changes, Bulgaria pp 11.

¹²Encyclopedia Americana, Vol. 23, pp 765, Climate Rumania.

¹³F&W Encyclopedia, Unicorn Press 1950, Climate (i.e. of the entire region.)

*These notes refer to items discussed throughout the chapter. Annotations were not used since it is felt that repeated reference was unnecessary; and, would actually detract from the chapter. To gain an appreciation of the problem of Climate and Weather in this region these books should be read in connection with the study of this chapter.

CHAPTER 5

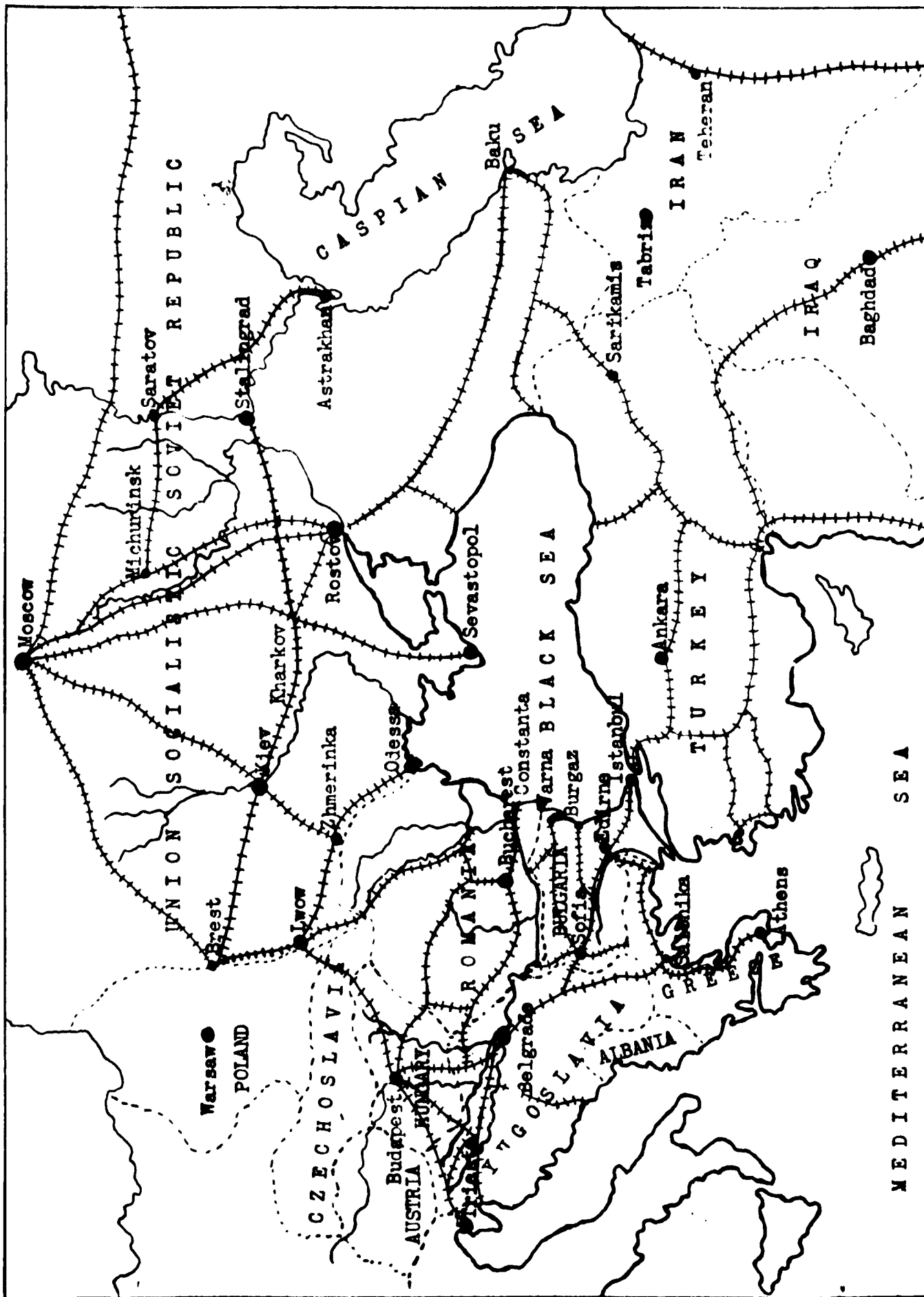
RAILWAY TRANSPORTATION

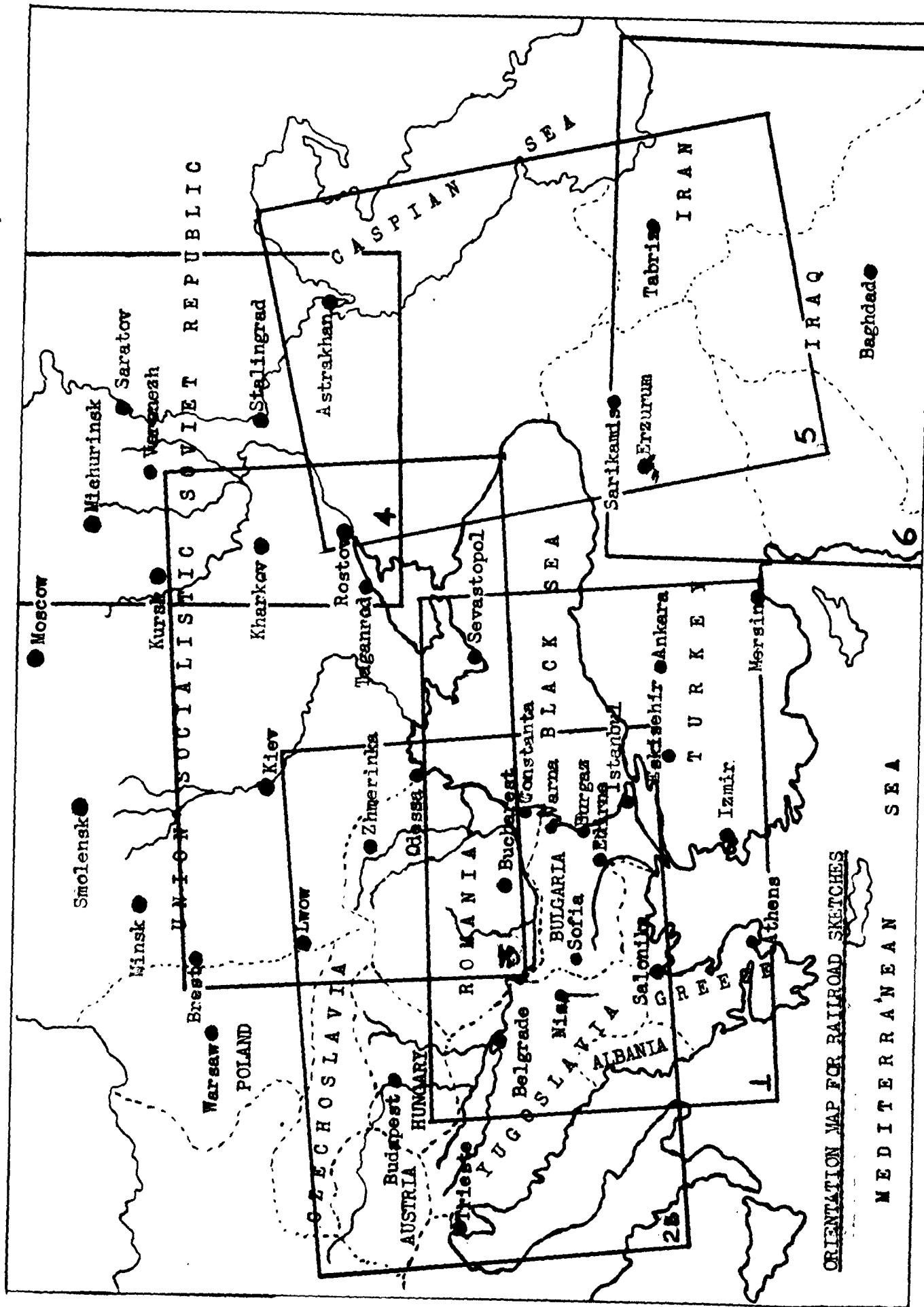
The railway systems of the countries in the area under study represent two major categories, standard gauge (4 foot, 8½ inches), and broad gauge, (5 foot). The railways of the Balkan countries, TURKEY and IRAN, are mostly standard gauge, and Russian railways are broad gauge.

Railroads in the whole area are characterized by inadequate maintenance and traffic facilities. This is militated by economic conditions in some cases, and in others is due to the unrepaid damage wrought by World War II. The general maintenance status and the gauge of Russian railways will be big factors in planning military operations in these areas, especially for armored support. Prior logistical planning will have to provide for vast maintenance capabilities, as well as the method of coping with the change of gauge problem.

Balkan Peninsula Countries

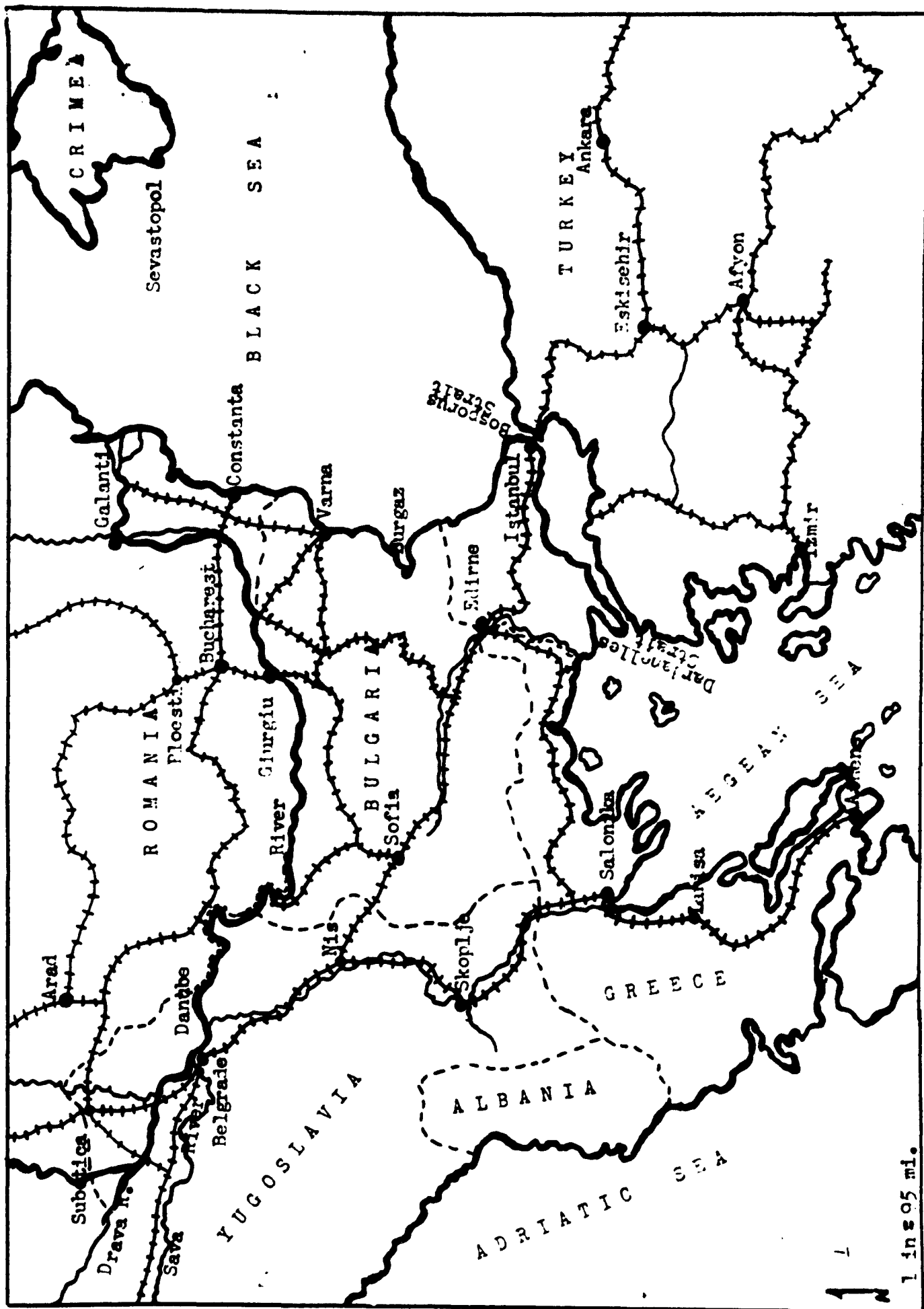
The Grecian railway system is of primary interest to armored logistics, inasmuch as it supports one of the main avenues of approach into the BALKAN PENINSULA. The routes of most interest are those centering on the strategic city of SALONIKA. This system is the national system, and it is of great importance due to its international connections and the fact that it is standard gauge. Only recently, since improved political relations between YUGOSLAVIA





ORIENTATION MAP FOR RAILROAD SKETCHES

MEDITERRANEAN SEA



and GREECE has come about, this system has become the connecting link between EUROPE and the NEAR EAST, replacing the rail route formerly passing through BULGARIA, which is now closed at the borders.

The SALONIKA-NIS line is the most important railway on the AEGEAN PENINSULA. The total length of the line is 283 miles, of which only the first 50 are in GREECE. Due to this railway having its terminus at the major strategic port of SALONIKA and the ATHENS systems, it is discussed under GREECE, being the controlling country of this avenue of approach to the BALKANS. The line is standard gauge, single track, without too difficult gradients and curves and has a reasonable number of sidings. This line is well laid and planned. The bridges are constructed of good iron with trusses and plate girders supported by stone and masonry pillars. The ties are cast iron or steel. The gradients average one foot in 160 feet, and only exceed one foot in 100 feet in three or four places, the steepest being one in 66 feet near KUMANOVO, YUGO-SLAVIA. Stations having sidings occur on an average of one every seven miles. This line follows the VARDAR RIVER valley most of the way to the GREEK border.

The ATHENS-SALONIKA line is a supporting route to the SALONIKA-NIS line, although it is believed the port of SALONIKA is capable of handling the tonnages that can be siphoned off by the railway to NIS. The ATHENS route is the longest in GREECE, 327 miles, and follows the age-long invasion route from the north into the

southern plains near ATHENS. It has several strategic weaknesses in that for great distances it follows narrow coastal strips bounded by rugged ridges and easily interdicted from the sea. Grades are steep, being one foot to 50 feet in many places, with two long viaducts vulnerable to interdiction. But the route could contribute considerable tonnages for operations, if required.

The other Greek railway constituting an avenue of approach into BULGARIA is the ALEXANDROUPOLIS-SVILENGRAD, BULGARIA line covering 115 miles. This line formerly connected with the Bulgarian system at SVILENGRAD, and it gains its importance from its south port terminus on the AEGEAN SEA. The route closely follows the west bank of the MARITSA RIVER to the TURKEY-BULGARIA-GREECE border area near EDIRNE, TURKEY. At EDIRNE the railway crosses the ARDA RIVER which flows into the MARITSA RIVER at this point, and constitutes the major possible barrier.

An east-west transverse route, SALONIKA-ALEXANDROUPOLIS, is important in that it links these two important ports, and also connects with the major highways entering BULGARIA from GREECE. Also in recent years this line has been connected by spurs to other port cities, between the two terminals, thus increasing its logistic capabilities. The line was built to run at least 12 miles inland to prevent vulnerability to naval attack, but, thereby, making it vulnerable to land attack from the north. The line passes through mountainous country and has several steep gradients, the steepest being one foot to 40 feet, just east of the DRAMA RIVER. This

TABLE I

GENERAL INFORMATION ON GREEK RAILWAY SYSTEM¹

<u>Line</u>	<u>Length of line</u>	<u>Maximum Gradient</u>	<u>Maximum radius of curves</u>	<u>Number of culverts</u>	<u>Number of bridges</u>	<u>Number of tunnels</u>
Salonika- Athens.	327 mi.	2.0 percent 1' to 50'	328 yards	1,229	153	58 (total 6 mis, 1038 yards)
Salonika- Nis. (Greek side only.)	50 mi.	1.0 percent 1' to 100'.	283 yards	32	64	—
Salonika- Alexandroupolis	277 mi.	2.5 percent 1' to 40'	328 yards	473	249	30 (total 2 mis, 1561 yards)
Salonika- Komenitsa.	125 mi.	2.5 percent 1' to 40'	261 yards	191	146	16 (total 1 mi, 1561 yards)

Note: The above railways are all standard gauge, (4 ft., 8½ in.) and represent the major lines of importance in Greece.

route crosses the STRUMA, MESTA, and DRAMA RIVERS, all being major streams. During the axis occupation there were plans for connecting this rail line with the Bulgarian system through the STRUMA RIVER valley. The total distance covered by this railway from SALONIKA to ALEXANDROUPOLIS is 276 miles.

The SALONIKA-KREMNITSA line serves the northwestern interior portion of GREECE, and furnishes an alternate to the NIS route into YUGOSLAVIA. It passes within 25 miles of the ALBANIA border at FLORINA and connects with the Yugoslav rail lines ten miles south of BITOLJ. The other major town served in GREECE is EDESSA. This railway traverses rough terrain and has a low tonnage capacity. It crosses the VARDAR RIVER 13 miles west of SALONIKA.¹

Bulgaria

Although the density of railroads per square mile and per person in BULGARIA is lower than most EUROPEAN countries, they are fairly evenly distributed, so that few locations are more than 20 miles from a railroad. The strategic value of the roadbed and trackage is greatly limited due to use of cheap materials and the inefficiency of conscripted labor. Recent press reports of Soviet dissatisfaction with Bulgarian railway operation has indicated the currentness of these deficiencies.

SOFIA is the main rail focus, being the center of State activity, with the backbone of the system being a fairly even grid

of two east-west lines and three north-south connections. From SOFIA a line runs east along the north flank of the BALKAN MOUNTAINS to connect with RUSE on the DANUBE RIVER and VARNA on the BLACK SEA. The other east-west line runs south and east on the south flank of the BALKAN MOUNTAINS to connect with BURGAS on the BLACK SEA, and runs toward TURKEY. This line formerly was a part of the Oriental Express Line from BERLIN to BAGHDAD. Due to border restrictions, BULGARIA has closed this international route. Although BULGARIA is the center of the crossroads between EUROPE and ASIA, its rail net has few ready connections with neighboring nations. Ferry crossings are required to reach ROMANIA over the DANUBE RIVER to the north.

Approximately 1,971 miles of railway is standard-gauge, constituting 87.2 percent of the total trackage. There is approximately 20 miles of double-tracked rail in the near vicinity of SOFIA. Length of sidings and additional trackage is comparatively small. The total length of tracks was only 117 percent of total length of line in 1938, compared to 226 percent in GERMANY and 168 percent in the UNITED STATES. Roadbeds are weak and inadequate, as little effort was made to move topsoil when necessary, and ballast is relatively light. Roadbeds are normally 16 feet wide, with ballast 1.2 feet deep and 9.8 to 11.2 feet wide. Wooden ties of oak and beech timber are used, except on the CARIBOD-PLOVDIV,

TABLE II
CHARACTERISTICS OF PRINCIPAL BULGARIAN RAILROAD LINES³

Line	Length (Miles)	Maximum Grade (percent)	Maximum Curvature (degrees)	Maximum Distance Between Stations (miles)
1. Caribrod-Svilongrad	226	2.5	6 4'	8
2. Sofia-Varna	285	2.5	8 7'	8
3. Sofia-Radomir-Simitli	89	2.0	5 8'	5
4. Sofia-Vrba-Gyuoshovo	52	2.5	8 7'	6
5. Ilientsi-Makotsovo	29	1.5	7 0'	12
6. Mozdra-Lom	74	2.2	8 7'	7
7. Brusartsi-Vidin	54	2.5	6 4'	6
8. Yason-Somovit-Nikopol	29	1.5	7 0'	4
9. Lovski-Svishtov	30	1.5	5 8'	8
10. Lovski-Lovoch	29	1.5	7 0'	10
11. Zimnitsa-Dubovo-Sopot	110	1.6	7 0'	7
12. Plovdiv-Burgaz	182	1.2	6 5'	9
13. Krichim-Pohstora	17	2.6	4 4'	8
14. Krumovo-Asonovgrad	6	1.3	4 4'	6
15. Rakovski-Momchilgrad	62	2.5	7 0'	9
16. Mikhailovo-Rakovski	19	1.5	5 8'	6
17. Ruso-Stara Zagora	160	2.5	7 8'	9
18. Shumen-Karnobat	83	1.2	4 4'	6
19. Ruso-Varna	140	2.4	9 1'	14
20. Iovkovo-Oberishto	32	---	----	9
Total	1,708			

TABLE III.

BULGARIA, CAPACITIES OF RAILROAD LINES UNDER NORMAL OPERATING CONDITIONS.³

Principio Lines	Number of trains per day in each direction	Average Gross weight per train		Average Daily net load in each direction	
		Metric tons	Short tons	Metric tons	Short tons
1. Caribrod-Svilongrad a. Caribrod-Plovdiv b. Plovdiv-Svilongrad	16 12	770 660	847 726	6,180 3,960	6,776 4,356
2. Sofia-Kaspichan (Varna) a. Sofia-Gorna-Orkhovitsa b. Gorna-Orkhovitsa-Varna	16 12	770 440	847 484	6,160 2,640	6,776 2,904
3. Sofia-Radomir-Simitli a. Sofia-Pernik b. Pernik-Simitli	16 12	770 550	847 605	6,160 3,300	6,776 3,630
4. Sofia-Vrba	12	550	605	3,300	3,630
5. Ilioutsii-Makotsovo-Gyuoshovo	12	550	605	3,300	3,630
6. Mosdra-Lom	14	550	605	3,850	4,235
7. Brusartsii-Vidin	12	550	605	3,300	3,630
8. Yason-Sorovit-Nikopol	12	660	726	3,960	4,356
9. Lovskii-Svishtov	12	660	726	3,960	4,356
10. Lovskii-Lovoch	12	550	605	3,300	3,630

Continued

TABLE IV

PRINCIPAL BRIDGES BY TYPE ON BULGARIAN RAILROADS³

1. Caribrod-Svilongrad	13 masonry and 35 iron girder bridges.
a. Sofia-Vakarol	14 masonry and 24 iron girder bridges.
b. Vakarol-Bolovo	13 masonry and 176 iron girder bridges.
c. Bolovo-Svilongrad	
2. Sofia-Varna	165 bridges (48 over 32 ft long), 135 metal, 61 stone, 2 ferroconcrete.
3. Sofia-Radomir-Simitli	5 bridges, unspecified type.
a. Vladaya-Radomir	3 masonry and 9 iron girder bridges.
b. Radomir-Dupnitsa	
4. Sofia-Gyuoshovo	4 masonry and 25 iron girder bridges.
a. Radomir-Kyustendil	13 masonry and 14 iron girder bridges.
b. Kyustendil-Gyuoshovo	
5. Ilientsi-Makotsovo	8 bridges, totaling over 10 miles of length.
6. Mezdra-Lom	54 bridges (longest 395 ft), 47 metal, 7 stone.
7. Brusartsi-Vidin	25 bridges, (longest 350 ft), 18 metal, 7 stone.
8. Yason-Somovit-Nikopol	29 bridges between Yason and Somovit. (only 1 over 32 ft long.) 21 metal, 4 stone, 4 wooden.
9. Lovski-Svishtov	6 bridges (2 over 32 ft.), 5 metal, 1 stone.
10. Lovski-Lovoch	No large bridges.
11. Zimnitsa-Dubrovo-Sopot	55 bridges, (10 over 32 ft span, longest 130 ft.) 44 metal, 4 stone, 7 ferro-concrete.
a. Simitza-Dubovo	10 bridges. All metal, longest 53 ft.
b. Tulovo-Kazanlik	

12. Plovdiv-Burgaz
180 bridges. 165 metal, 15 stone. (Excludes section from Nova Zagora to Yambol for which no details are available.)
13. Krichim-Poshtorn
8 bridges. 3 metal, 5 concrete.
14. Krumovo-Isonovgrad
Only two bridges. 3 masonry, 1 iron. No details available.
15. Rakovski-Monchilgrad
51 bridges. 24 metal, 27 masonry.
16. Mihailovo-Rakovshi
4 bridges.
17. Ruso-Stara Zagora
a. Ruso-Trnovo
b. Trnovo-Plachkovtsi
c. Plachkovtsi-Borushtitsa
d. Borushtitsa-Dubovo
e. Dubovo-Star Zagora
12 masonry and 26 iron girder bridges.
31 masonry and 25 iron girder bridges.
8 masonry and 1 iron girder bridge.
5 iron girder bridges.
7 masonry and 7 iron girder bridges.
18. Shumen-Karnobat
About 22 bridges.
19. Ruso-Varna
69 bridges. 64 metal, 5 stone.
20. Iovkovo-Oborishto
No data.

TABLE V
TUNNELS ON PRINCIPAL BULGARIAN RAILROADS.³

1. Caribrod-Svilengrad	No tunnels.
2. Sofia-Kaspichan (Varna)	22 tunnels. Total length 12,600 ft. Longest is 1,440 ft., between Rebrovo and Svoge.
3. Sofia-Radomir-Simitli	3 tunnels. Longest is 800 ft., between Rebrovo and Svoge.
4. Sofia-Vrba-Gyueshevo	22 tunnels. Longest 1,335 ft. (9 tunnels, 13 to 650 ft long, and 5 tunnels 650 to 1,335 ft long, between Radomir and Kyustendil. 8 tunnels between Kyustendil and Gyueshevo.)
5. Ilientsi-Makotsevo	No tunnels.
6. Mesdra-Lom	No tunnels.
7. Brusartsi-Vidin	2 tunnels. Total length 1,350 ft., longest 850 ft.
8. Yasen-Somovit-Nikopol	No data.
9. Levski-Svishtov	No tunnels.
10. Levski-Lovech	No tunnels.
11. Zimnitsa-Jubovo-Sopot	At least 1 tunnel about 1,500 ft long under Strazhata watershed.
12. Plovdiv-Burgaz	No tunnels.
13. Krichim-Pashtera	No tunnels.

Continued

14. Krumovo-Asenovgrad
No data.
15. Rakovski-Momchilgrad
3 tunnels. Total length 4,900 ft., longest 3,670 ft which is between Knizhovnik and Perperek at Most stop, longest in Balkans.
16. Mikhailovo-Rakovski
1 tunnel, between Brest and Marilino, length 731 ft, 1 mile north of Maritsa River bridge.
17. Ruse-Stara Zagora
 - a. Ruse-Trnovo
2 tunnels.
 - b. Trnovo-Plachkovtsi
6 tunnels.
 - c. Plachkovtsi-Borushtitsa
11 tunnels.
 - d. Borushtitsa-Dubovo
5 tunnels.
 - e. Trnovo (under town)
2 tunnels, longest 535 ft.
 - f. Trnovo-Develets
Tunnel lengths 900 ft.
 - g. Drenovo-Tsareva Livada
Tunnel lengths over 650 ft.
 - h. Plachkovtsi-Krustets
Tunnel lengths 4,400 ft.
 - i. Raduntsi-Yavrovets
Tunnel lengths 1,935 ft.
18. Shumen-Karnobat
3 tunnels, 240, 230 and 80 meters in length.
19. Ruse-Varna
No tunnels.
20. Iovkovo-Oborishte
No works of importance.

SOFIA-GORNA OREKHOVITSA, and SOFIA-PERNIK lines. In 1934, only 16 percent of track was laid with 82-pound rail, 12 percent with 70-pound, and 72 percent is less than 70 pounds per yard.

The mountainous character of the country made railroading difficult. Grades and curves are near maximum allowable, bridges are numerous, tunnels necessary in many instances, and station stops are close together.³

Yugoslavia

The YUGOSLAVIA railway net is underdeveloped in scope, with a total mileage of 6,926 miles of State owned routes in 1949.² Most of the railway system is international in character. Because of rugged mountainous terrain the railway system has not been fully developed along the coastline of the ADRIATIC SEA. The main rail line could be described as the spinal cord of the country, starting at TRIESTE and traversing the entire length of the hinterland and terminating at SALONIKA, GREECE.

Parts of this line have already been described under Greek railways. The route at present constitutes the main link of the Oriental Express Line. From NIS, a roadbed exists toward SOFIA to the east. The line crosses the SAVA RIVER in BELGRADE, then travels westward along the SAVA RIVER valley to ZAGREB. The city of ZAGREB is an important junction, as one roadbed runs northeast to BUDAPEST, one southwest to FIUME, and the main route proceeds west over the DINARIC ALPS to TRIESTE. The latter branch makes main connections

into AUSTRIA and ITALY.

An alternate rail route generally paralleling the ZAGREB-BUDAPEST line exists as a branch northeast from the YUGOSLAVIA-AUSTRIAN border. Another important rail axis is SUBOTICA, the northernmost city in YUGOSLAVIA, located between the DANUBE RIVER and TISA RIVER. These two routes have strategic significance for military operations in that they follow the approaches into CENTRAL EUROPE from the MEDITERRANEAN, furnishing the easiest movement for armor columns.

Two minor rail lines thread through the rough YUGOSLAVIA mountains to serve the ports of SIBERNIK and DUBROVNIK. The path of these routes are of doubtful offensive military value, in view of the above discussed routes following natural routes.

All YUGOSLAVIA'S railways are standard gauge. Although detailed technical data is not available, it is logical to assume that these routes would closely resemble the Bulgarian and Grecian lines in general characteristics.

Romania

The character of Romanian railways closely resemble that of YUGOSLAVIA, inasmuch as the route circles the TRANSYLVANIA ALPS and CARPATHIAN MOUNTAINS to follow the lowlands of the DANUBE RIVER and SERE RIVER. In 1938 the total mileage was approximately 6,915 miles, whereas in 1948 the trackage was reported to be 7,000 miles.⁴ Some mileage was lost to neighboring countries, principally RUSSIA.

and HUNGARY as a result of the Peace Treaty of 1947. Therefore, if these mileage figures are correct, it would indicate that new trackage has been constructed.

The ROMANIAN transportation system bore the logistical burden of large scale military operations in World War II. ROMANIA escaped the initial destruction phase by joining the Axis. But as a result her resources were geared to supporting the Axis. Then as the Germans began to retreat, two Soviet armies crossed ROMANIA to make an envelopment of CENTRAL EUROPE, and to isolate the remainder of the BALKAN PENINSULA. This movement of military forces included large armored formations, which attests to the ability for armor to operate in pursuit operations in the BALKAN area.

The principal transport of ROMANIA'S commerce is inland water shipping on the DANUBE RIVER. For this reason the railway system has developed to supplement the river shipping. Although the main rail route tends to parallel the DANUBE RIVER, it tends to provide feeder transport inland for important commercial activity. This main line starts at CONSTANTA, the BLACK SEA port. It crosses the DANUBE RIVER at CERNAVODA over a massive bridge, and then proceeds due west to the capital city of BUCHAREST. The road then continues westward over numerous DANUBE tributaries and passes through the IRON GATE gorge where the TRANSYLVANIA ALPS hinge on the DANUBE RIVER. The route then continues west and north over more mountainous terrain to connect with SUBOTICA in YUGOSLAVIA and SZEGED in HUNGARY. This route is connected by branch lines reaching to DANUBE ports on

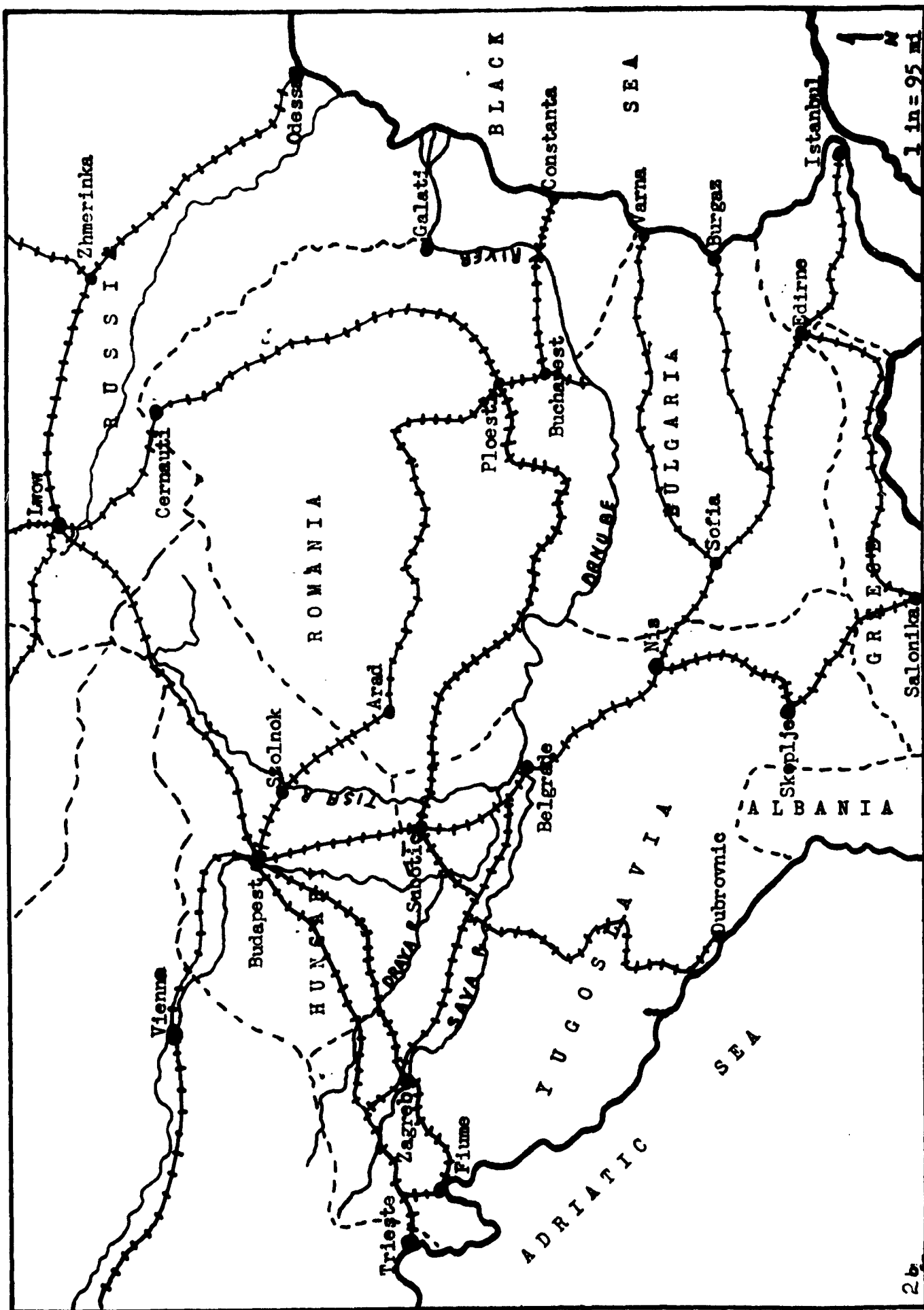
at least eight points in ROMANIA. A few minor routes reach into the industrial areas in the mountains.

The rail line of next most importance runs north of BUCHAREST to connect with LVOV, the strategic Soviet center. This route passes through PLOESTI, the rich petroleum center, then follows the SERE RIVER valley to CERNAUTI in northern ROMANIA. Although this line skirts the eastern edge of the CARPATHIAN MOUNTAINS, with few exceptions it is well laid along lowland and level routes. The line is believed to bear the bulk of the overland traffic between RUSSIA and the BALKANS.

Another important route runs northwest from PLOESTI across the TRANSYLVANIA ALPS, then turns west crossing the mountainous area of the country to ARAD. From ARAD, a main connection runs northwest into HUNGARY to BUDAPEST. This route goes over several mountain passes, and follows mountain stream valleys for considerable distances. This route is not to be discounted as a military route. The northern flank Soviet army that passed through ROMANIA in pursuit of the German Army used this general route.

The major rail heads on the DANUBE RIVER are at GIURGIU, south of BUCHAREST, at BRAILA, and at GALATI located down river at the great bend from the northern course, toward the east to the BLACK SEA. These routes are the major commercial outlets of the country.

All ROMANIA'S railways are standard-gauge, and with few exceptions all are single-tracked. Little detailed information is



available, but it is assumed that postwar reconstruction has been burdened both by repairing war damage, and helping support Soviet economic demands. The general characteristics of the maintenance status probably is on a par with RUSSIA'S railroads.

Hungary

In 1949 the total railway mileage in HUNGARY was 4,773 miles.⁵ BUDAPEST is the hub, from which routes radiate to the borders. Due to the geographic location of HUNGARY, the transportation system handles a large volume of transient commerce. The rail system is secondary to inland water transport and serves the rich outlying agricultural regions. Because of the sustained battles fought during early 1945 by the German and Russian armies, the countries' railways suffered severe damage. Since the war they have borne reparations losses, and logistically supported Soviet forces in AUSTRIA.

The principal routes radiating south from BUDAPEST are five in number. Four of these make direct connections in YUGOSLAVIA, and generally follow unrestricted terrain. The two most important are the routes running southwest toward the port of TRIESTE. These routes have carried the bulk of CZECHOSLOVAKIAN and HUNGARIAN commerce from Western Nations. Two other routes into YUGOSLAVIA are strategic because they travel south between the DANUBE and TISA RIVERS. As an avenue of approach these routes enjoy a certain amount of flank protection. Another route runs east from BUDAPEST, crosses the TISA RIVER, and connects with the ROMANIAN system at ARAD.

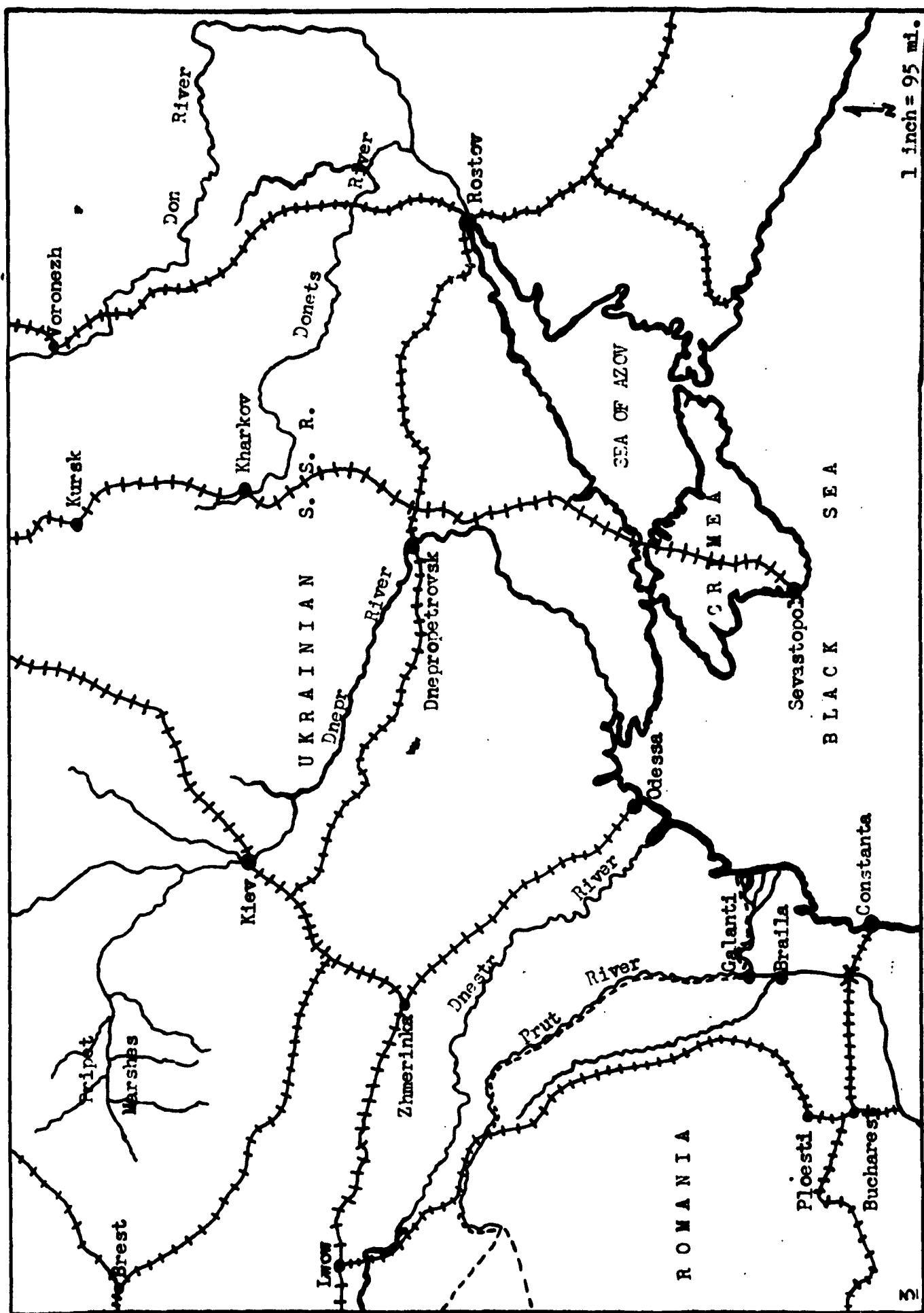
The rail complex of northern HUNGARY connects at nearly a dozen points with the highly industrialized regions of CZECHOSLOVAKIA. An important main line follows the DANUBE RIVER to connect BUDAPEST and VIENNA, AUSTRIA. The main route crossing CZECHOSLOVAKIA runs northeast from BUDAPEST to MISKOLC. At the latter point it branches out to serve northeastern HUNGARY. Two principal branches of interest cross the high passes through the CARPATHIAN MOUNTAINS and converge on LVOV in RUSSIA. These two would be of possible military significance if it were necessary to use this avenue of approach into RUSSIA.

All Hungarian railways are standard-gauge, and all are single-tracked. The system in the southern area is generally characterized by alternate routes and supplement inland water routes.

South European Russia⁶

Soviet Russian railways provide the principal means of transportation, and form the backbone of this highly centralized state. All major railroads radiate from MOSCOW to the four directions. In spite of the broad expanses of SIBERIA, 62 percent of RUSSIA'S trackage is in the area generally west of a north-south line through MOSCOW.

In the areas west and south of MOSCOW, the most dense area is the southwest quadrant where few points are more than 25 miles from a railroad. It is in this area that rich, level agricultural areas are tapped, and the Balkan Satellites have their umbilical connections with the Mother State. This area has the only



standard-gauge track known to be in RUSSIA in 1947. This standard-gauge line paralleled the broad gauge line between LVOV and KIEV. Its primary purpose was to permit reparations shipments from EUROPE to be brought deep into the Soviet spider web before transshipment was necessary. KIEV is the main rail center of this area, due to its location on the DNEPR RIVER.

The quadrant southeast of MOSCOW includes the connections to the strategic BLACK SEA port of SEVASTOPOL and ROSTOV at the mouth of the DON RIVER. Other major connections are with points along the VOLGA RIVER, down to ASTRAKHAN on the CASPIAN SEA, and a route through the CAUCASUS MOUNTAINS into northeastern TURKEY. Five of the eleven tunnels on EUROPEAN RUSSIA'S rail lines are located on the main line immediately north of the CRIMEA AREA. Three other tunnels are in the same area on less important lines. Approximately 50 percent of the Russian trackage was located in the area overrun by the Germans in World War II. Many of the bridges destroyed are now replaced by temporary expedients. Other major bridges were structurally weakened by the ravages of war. Thousands of bridges are required to cross the numerous rivers, streams, canals, and marshes of the broad WEST RUSSIAN PLAIN. Many of the bridges across the larger rivers are particular important targets, or conversely important objectives for fast moving armored columns. Compacted roadbeds through marshes, on curves, and at bridge approaches are sources of constant maintenance requirements. Stresses caused by seasonal freezes and thaws further the complicated

maintenance problems of road beds and bridging. Roadbed ballast of sand is the greatest deficiency, tending to be unstable when wet, and blows away when dry.

In 1941, double tracked lines representing 21 primary routes, constituted 63 percent of the total track. At the end of World War II secondary tracks, sidings, and switch yards were cannabilized for replacement of worn out tracks on the main routes. About 6,200 miles of track destroyed by the Germans during their retreat was replaced with broken rails. The 1946-50 five-year-plan called for 31,000 miles of replacement track to be produced. It is doubtful this figure was reached. The main priority in the southern area was given to the MOSCOW-DONBASS BASIN area lines. Russian broad-gauge is five feet. There are few grades as great as two and one-half percent, with most less than one and one-half percent. Ties are made of pine, spaced with approximately 2,770 per mile. Rail is mostly 77.4 pounds to 87.9 pounds per yard, with a pre-war common length of 41 feet per rail.

The MOSCOW-SMOLENSK-MINSK-BREST route, comprising 668 miles of double-tracked roadbed, is the main east-west link between MOSCOW and the EUROPEAN capitols of WARSAW and BERLIN. This route, which crosses the northern half of the PRIPET MARSHES, was the axis of the German advance toward MOSCOW. Seven bridges ranging from 226 feet to 450 feet long are known to be on this line, totaling 2,335 feet. The longest bridges are the DNEPR and LESNA RIVER bridges of 226 feet and 436 feet respectively.

The MOSCOW-KIEV-ZHMERINKA line is 700 miles long, and it

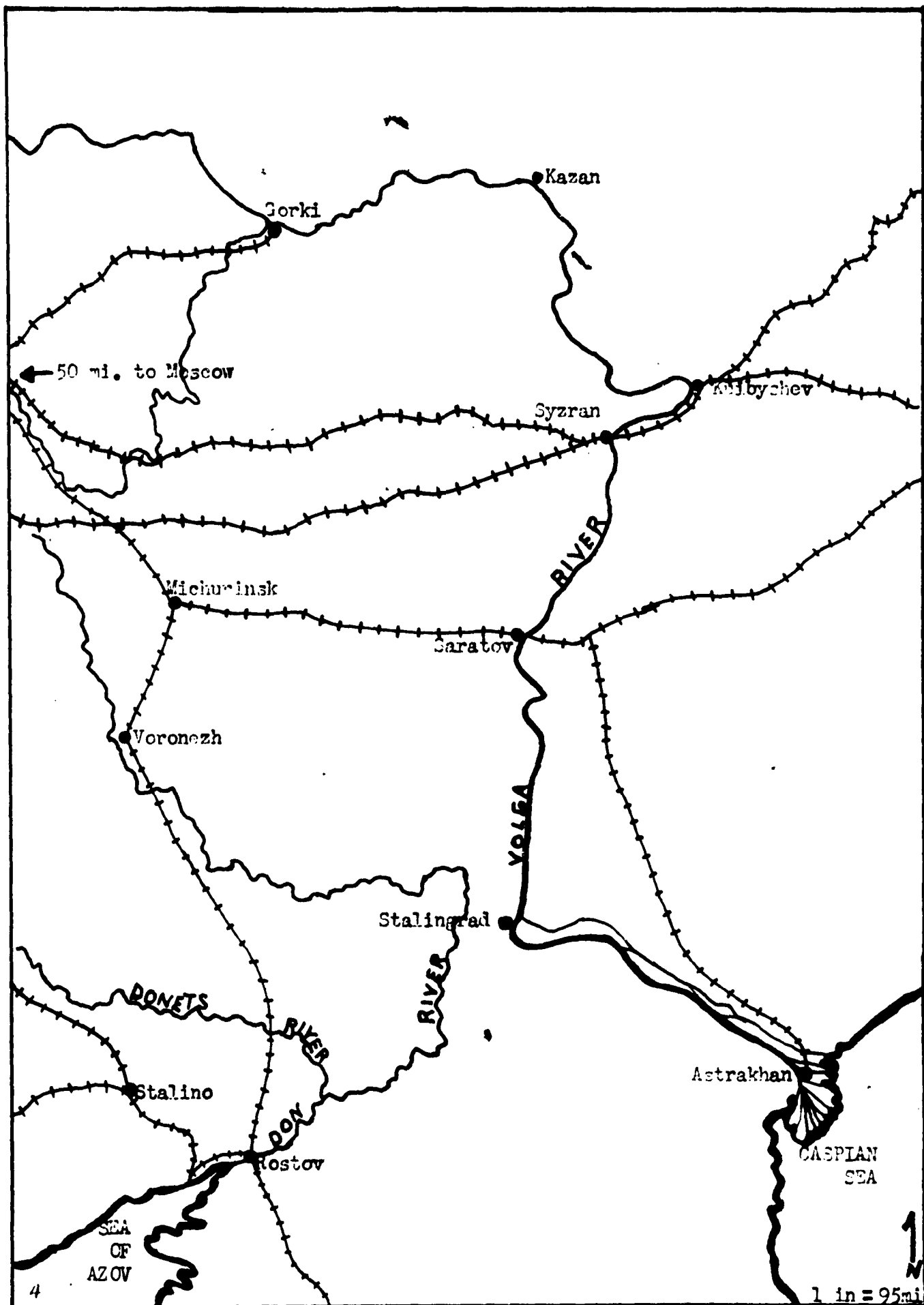
siphons off toward MOSCOW the commerce of the strategic LVOV-ODESSA route. During double-tracking of this line in 1947, the Soviets kept the German built standard-gauge track between KIEV and ZHEMERINKA intact. A broad-gauge track was laid along side the standard gauge. This arrangement also exists from ZHEMERINKA northwest to LVOV where standard-gauge connections extend into WESTERN EUROPE. KIEV is the chief city on this line, rating as the largest inland river port of RUSSIA, being on the DNEPR RIVER. An important secondary route runs northwest from KIEV to WARSAW, and southwest to ROSTOV. There are nine bridges more than 240 feet long, totaling 7,500 feet of bridging. The longest bridge is the DNEPR RIVER bridge, which is 3,500 feet long, being a 12 span railway-highway bridge.

The MOSCOW-KURSK-KHARKOV-SEVASTOPOL railway is the only direct route from the strategic CRIMEAN PENINSULA direct to MOSCOW. It is connected with several primary transverse lines, which fit into the web extending from MOSCOW into the UKRAINE and DONBASS BASIN areas. This route is 933 miles long and was scheduled to be double-tracked by 1950. The tunnels just north of SEVASTOPOL were severely damaged during World War II. It is not known what the nature of the construction was over the soft area connecting the CRIMEA PENINSULA to the mainland. The Soviet Army effected a crossing by dirt fill in 1944. The 1,475 foot dual railway-highway bridge over the OKA RIVER is the longest bridge on the route.

The MOSCOW-ROSTOV lines consist of two routes which are approximately 80 miles apart. The western route is about mid-way between the eastern route and the MOSCOW-SEVASTOPOL line. It passes through the ports of TAGANROG and ROSTOV on the SEA of AZOV, and continues southeast enroute to the CAUCASUS AREA. This roadbed is 817 miles long, is triple-tracked for about 56 miles south of MOSCOW and double-tracked the remainder. There are eight or nine bridges known to be longer than 246 feet. The longest is believed to be a single-tracked bridge over the OKA RIVER which is 2,050 feet long, having five equal spans. The other MOSCOW-ROSTOV line passes through MICHURINSK, VORONEZH, and KAMENSK, for a total length of 762 miles. The largest bridge on this route is the OKA RIVER bridge near KOLMA, a 1,781 foot double-tracked, truss girder bridge.

The MICHURINSK-SARATOV-ASTRAKHAN railway connects with the latter of the above discussed lines at MICHURINSK. This is the only rail link between CENTRAL RUSSIA and the important port city on the CASPIAN SEA. The route is 691 miles long, and according to 1946 time tables it was about 75 percent double-tracked. There are five known bridges totaling 14,950 feet of structures. The longest is 5,520 feet across the VOLGA RIVER at SARATOV.

The LVOV-ZHMERINKA-ODESSA line roughly parallels the DNESTR RIVER for 459 miles between the main terminals. It is the trunk line nearest the borders of ROMANIA, HUNGARY, and CZECHOSLOVAKIA, with 14 junction points entering those satellite countries. At the important port of ODESSA, connections are made with coastal

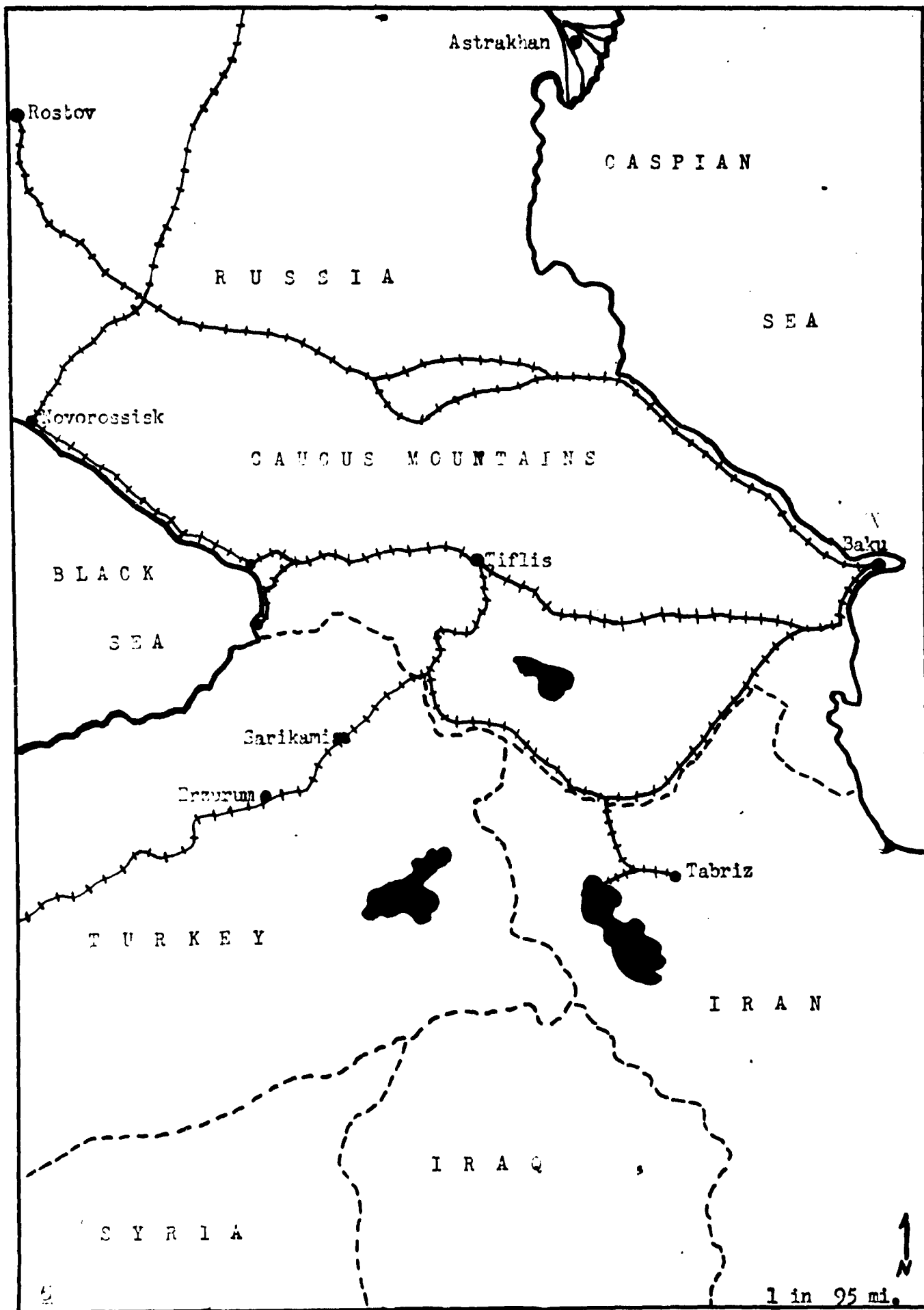


routes going south into ROMANIA. It is believed the total length of this line is double-tracked, with the LVOV-ZHMERINKA section having a standard and broad-gauge track as stated above. There are few major bridges on this route.

The last major railroad deemed important for this discussion is the BREST-STALINGRAD railroad. This trunk line is the longest in EUROPEAN RUSSIA, with a total distance of 1,323 miles covered. It traverses the southern arc at a distance of 550 to 600 miles radius from MOSCOW. The entire line was to be double-tracked by 1950. There are 11 known bridges of more than 250 feet length, totaling about 11,220 feet. All the major rivers of SOUTH EUROPEAN RUSSIA are crossed, with the largest bridges being located over the DNEPR RIVER and DON RIVER.

Turkey

Railways as well as highways in TURKEY are very inadequate. In 1948 the total mileage of rail lines was 4,652 miles, all State owned.⁷ There are no alternate routes, and distances between rail facilities are vast. Railroad development in TURKEY was mostly by foreign initiative. German insistence was mostly responsible for the Oriental Express Line that crosses TURKEY to BAGHDAD, and a stretch of Russian broad-gauge extending down from the CAUCACUS MOUNTAINS attests to Russian ambitions. Present UNITED STATES Aid to TURKEY has established programs for improving maintenance facilities and bettering efficiency of operation.



The main rail route across TURKEY enters from BULGARIA at EDIRNE. The border between BULGARIA and TURKEY is closed at the present time, but the International Route has been resumed through GREECE. This route has ferry crossing connections across the BOSPORUS STRAITS. It then runs southwest across TURKEY, entering SYRIA and continues to BAGHDAD, IRAQ, and on to port facilities near the PERSIAN GULF.

The single main route across CENTRAL TURKEY branches eastward from the above route at ESKISEHIR to ANKARA and on eastward into the CAUCACUS MOUNTAINS. From the town of SARIKAMIS to the border, broad gauge lines are laid and cross an area which recently has been demanded by the Soviets. Narrow-gauge connects the Turkish standard-gauge with the Russian broad-gauge between ERZURUM and SARIKAMIS.

Two branch routes connect this long line with the sea outlets on the BLACK SEA. The principal lines serving outlets on the AEGEAN SEA and MEDITERRANEAN SEA are the lines to IZMIR and MERSIN respectively. The latter port is secondary in importance and is near the SYRIAN border. The port of IZMIR generally faces ATHENS across the AEGEAN SEA.

Turkish railways in most areas cross rolling to rugged terrain. For heavy military traffic constant maintenance would be required. Lack of way stations and sidings are a traffic problem.

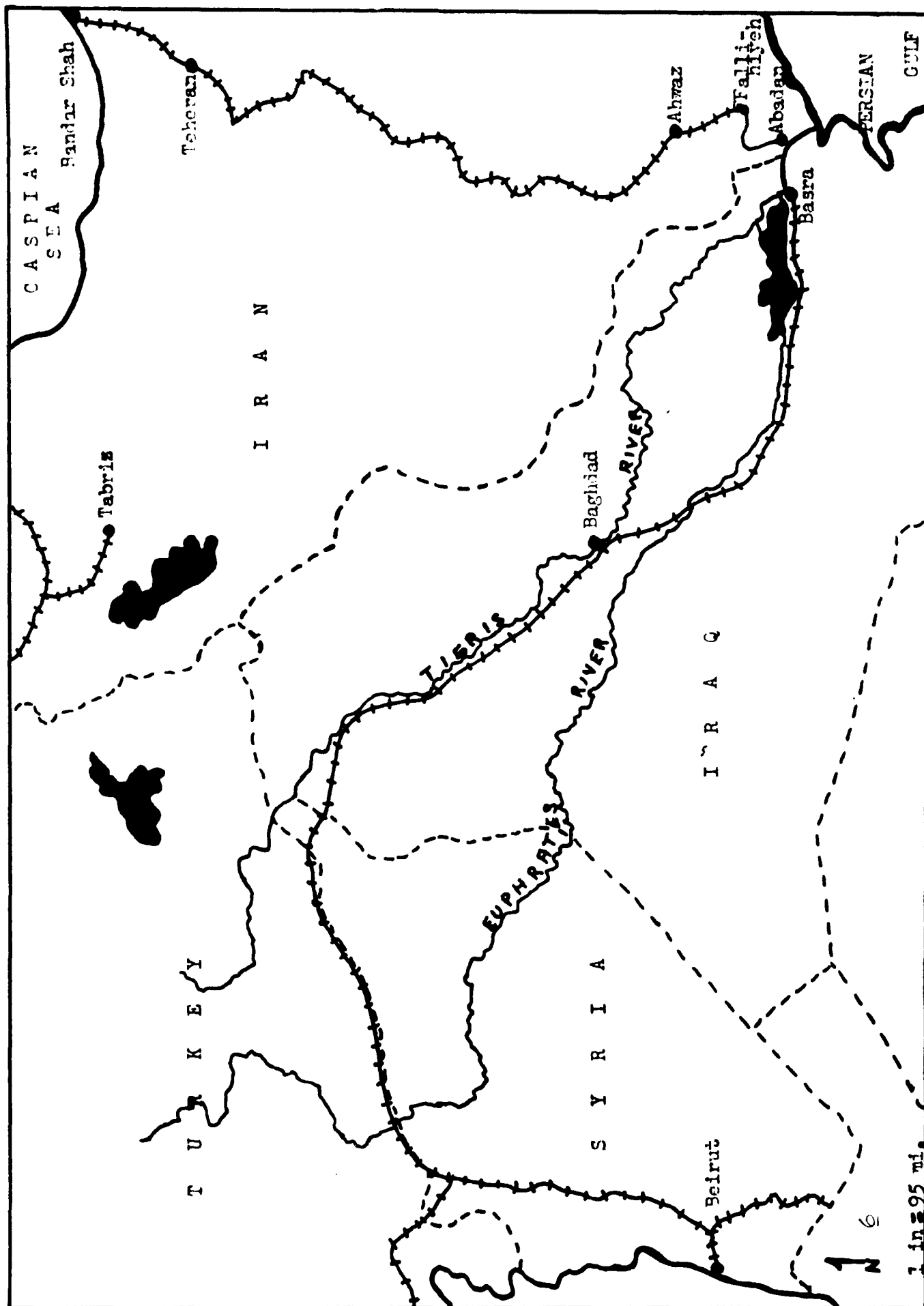
Iran

In 1948 Iranian rail lines open to traffic totaled 1,748 miles.⁸ Of this mileage, the principal line between the PERSIAN GULF and the CASPIAN SEA constituted 870 miles. This rail line was the artery that moved five million tons of lend-lease equipment to the Russians during World War II.⁸ This line crosses fairly mountainous areas, and has numerous tunnels. For offensive combat into SOUTHERN EURASIA it would possibly again have strategic significance.

Iraq, Syria, Lebanon and Israel.

State owned railroads of IRAQ total 1,555 miles of standard-gauge trackage.⁹ Most of this distance is covered by the eastern terminus of the famous Oriental Express Line or Berlin to BAGHDAD route. The rail line enters northwestern IRAQ from SYRIA, then follows the TIGRIS RIVER VALLEY to BAGHDAD, in the center of the country. The route then goes southward to cross the EUPHRATES RIVER and follows that river to BASRA. The terminus at BASRA is approximately 100 miles inland at the junction of the TIGRIS and EUPHRATES RIVERS. The TIGRIS RIVER is navigable for ocean going vessels to BASRA.

LEBANON and ISRAEL constitute the east flank of the MEDITERRANEAN SEA. The railways of these small nations gain their importance by providing connections from CAIRO to ISTANBUL. They also serve the important ports of HAIFA, BEIRUT, and TRIPOLI.



In 1951, ISRAEL'S railways totaled 205 miles, with the main route closely following the coastline from the Egyptian border to Haifa. It then goes inland to SYRIA and to DAMASCUS.¹⁰

In 1949, SYRIA'S rail lines totaled 539 miles, and consisted of a line running to BEIRUT in LEBANON, built by Allied Engineers during World War II.¹⁰ Both the PERSIAN GULF rail connection and the SUEZ CANAL rail line pass through SYRIA to TURKEY.

The rail communications of these small countries have strategic significance for supporting defensive operations in EASTERN TURKEY and the MID-EAST oil regions.

NOTES FOR CHAPTER 5

¹Strategic Study of Greece, ONI-113, Report prepared by the Office of Naval Intelligence (Washington, ONI, July 1943) Vol II.

²John Kiernan, Information Please, Almanac (New York: The Macmillan Co, 1952), p 590.

³Joint Army-Navy Intelligence Study No. 38, Military Intelligence Division, War Department General Staff, October 1943, Vol. 2, pVII-6.

⁴Encyclopedia Americana, (New York, Americana Corporation, 1946) Vol. 23, p 767.

⁵Op cit, Information Please, p 515.

⁶Joint Army-Navy Intelligence Study No. 40, Military Intelligence Division, War Department General Staff, Part VII, pp 1-29.

⁷Op cit, Information Please, p 579.

⁸Op cit, passim p 518.

⁹Op cit, passim p 519.

¹⁰Op cit, passim pp 575; 535.

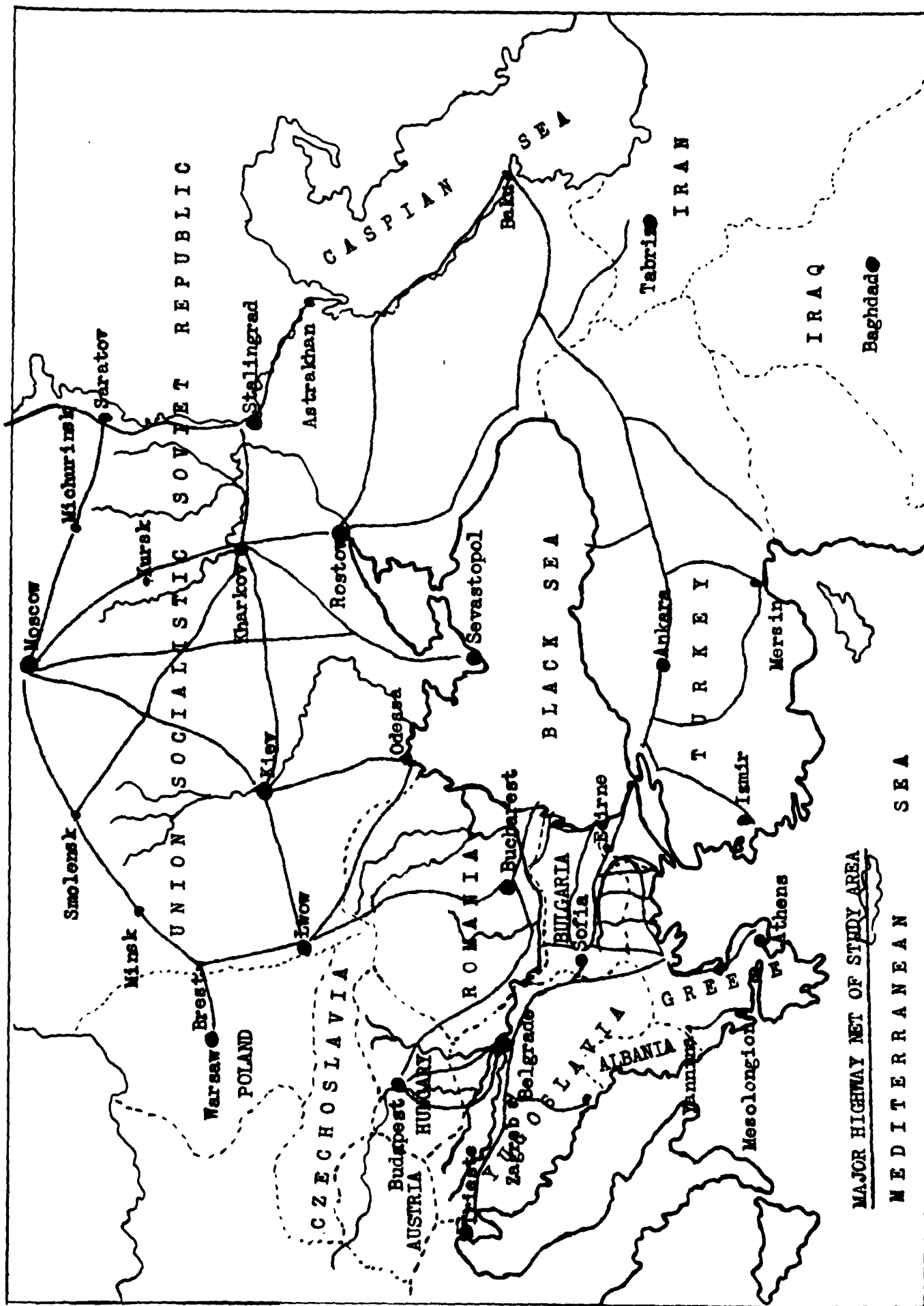
CHAPTER 6

HIGHWAY TRANSPORTATION

Modern highways of the type recognized by Americans are non-existent in the BALKANS, RUSSIA, or the MID EAST. Lack of automotive industry for free enterprise and products for consumer goods has prevented an incentive or need for multi-laned, hard surfaced roads. Motor roads are in most cases improved trails that have existed for centuries on natural avenues for travel.

The mountainous character of the BALKAN PENINSULA causes road, rail, and river transport to be parallel in most cases. This favors the defender, as each defile and mountain pass is a potential strongpoint. The unimproved nature of the mountain roads would present constant maintenance requirements for military traffic. Road widths on the average are barely sufficient for normal two-way traffic. For armored columns most roads would only allow one-way traffic. These factors of maintenance and traffic control are not insurmountable problems for well planned armored warfare.

The highways in SOUTH EUROPEAN RUSSIA present a problem of a different nature. These roads which cross broad flat plains cross numerous streams, and major rivers are not few. All-weather roads, as such, are normally those that have been surfaced to allow the local light traffic a degree of all-weather movement. Spring thaws tend to give the deep loam and back earth soils bottomless ruts. The accompanying flooded streams and rivers are an added major consideration. The area under study was the scene of the largest



MAJOR HIGHWAY NET OF STUDY AREA

MEDITERRANEAN SEA

armored and mechanized battles of World War II. Therefore lessons learned by others, and prior planning to overcome terrain and seasonal obstacles should enhance future armored campaigns in the area.

Greece¹

The highway system in GREECE was not extensively developed due to the barren and mountainous nature of the terrain. The whole system is comprised of approximately 9,674 miles of roads. A 2,000 mile coast line has diverted internal products along shipping on cheap coastal steamers. Also due to the general poverty of the country, and limited Greek engineering capabilities, existing highways are far from first class.

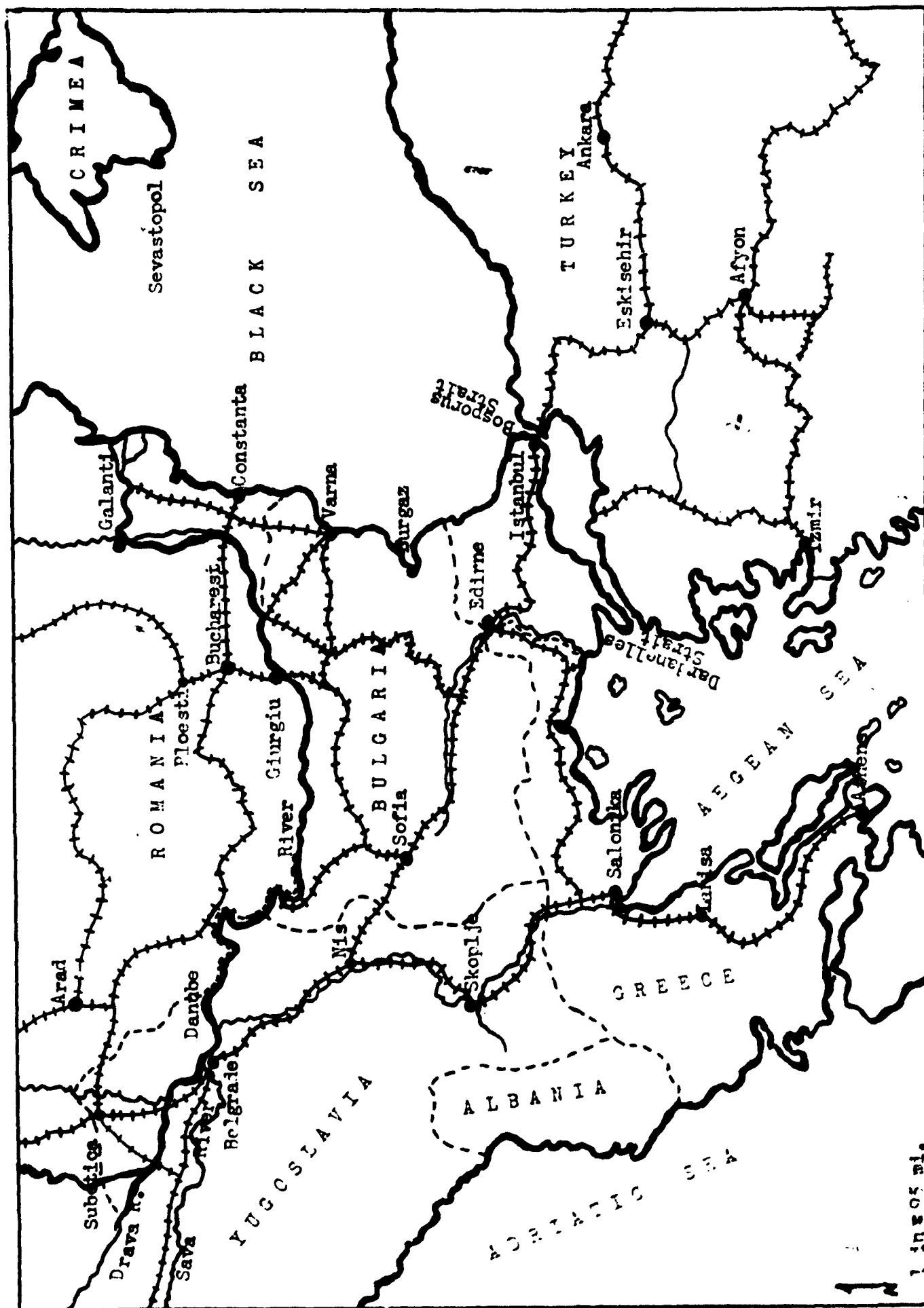
Roadways were poorly graded in general, and covered with layers of broken stone which ruts deeply under heavy travel. The best roads are paved with waterbound macadam or surface penetration asphalt. The shoulders in many places are a vertical stone or concrete wall ranging from six inches to three feet, with no guard rails. These shoulders were designed to prevent inundation during flash mountain showers and lowland flooding. It was reported that German armor had difficulty on Greek roads because of this factor. The better roads average 17 to 20 feet in width, have maximum grades of six percent, but have many sharp turns through hill areas. United States aid to GREECE since 1946 has concentrated on rehabilitating the transportation system. It is reported that by 1950, there were 1,730 miles of asphalt roadways in GREECE.²

The main Grecian highway connects ATHENS with SALONIKA, a distance of 351 miles, and is the backbone of all land travel in GREECE east of the PINDUS RANGE. This road generally follows closely the railroad connecting these two cities. The principal bottlenecks of this road are the restricted passages through towns and villages. Although it was built as a military highway, it is doubtful if traffic could average much over 20 miles per hour.

Another north-south route on the west side of the PENINSULA travels from MESOLONGHI, a southern port, northward to YANNINA. This road connects with unimportant branches extending east into the mountains, and terminates in the center of the EPIRUS area, which offers little strategic significance.

The road of second importance in GREECE, is the route going generally eastward from SALONIKA through the areas of MACEDONIA and THRACE to TURKEY. Again this route follows the railway, and gains its importance as a lateral connector of the routes that penetrate northward into BULGARIA from the towns of SERRAI, DRAMA, XANTHI, and KOMOTINE. The route distance from SALONIKA to SERRAI is 54 miles, another 40 miles to DRAMA, 52 miles further to XANTHI, and the final 34 miles to KOMOTINE.

Most of the area traversed by this route is hilly, except in the VARDAR, STRUMA, MESTA, and MARAITSI RIVER valleys, which are crossed by the road. The lowland areas are liable to flood in winter and early spring. This route is connected to major coastal points by branches of generally unimproved roads, but capable of



being maintained for military traffic. This road also connects with the SKOPLJE, YUGOSLAVIA railway and highway, connecting YUGOSLAVIA and GREECE through the MONASTIR GAP.

Yugoslavia

The road mileage in YUGOSLAVIA is very inadequate and poorly maintained. Of an estimated 20,646 miles of roads, all are country dirt roads with the exception of the BELGRADE-ZAGREB-LJUBLJANA super-highway which is still in the construction stage.³ The movement of heavy military vehicles and equipment on Yugoslav roads would require constant maintenance because of inadequate mileage of hard-surfaced highways. Foot troops and light vehicles are not so limited and can move relatively freely in most areas except some sections in mountains restricted by snow and rough terrain.

The principal strategic routes center on BELGRADE, the most important of which is the BELGRADE-ZAGREB-LJUBLJANA super-highway which generally follows the SAVA RIVER valley. The importance of this route rests on its being connected with both port cities of TRIESTE and FIUME, and offers a fairly easy entrance to the CENTRAL DANUBIAN PLAIN of HUNGARY and north YUGOSLAVIA. Fairly well improved roads cross a stretch of quite rugged cliff country to connect the seaports of TRIESTE and FIUME with LJUBLJANA, but generally offers the shortest and most accessible route of approach to the heart of the BALKANS and EASTERN EUROPE.

There are two routes which connect BELGRADE with HUNGARY.

One of these roads travels northwest from BELGRADE, crossing the DANUBE RIVER by ferry near NOVA SAD, then going north between the DANUBE and TISA RIVERS to BUDAPEST. With the exception of climatic considerations and the crossing of the DANUBE RIVER, this route offers easy movement for armored formations northward to the CARPATHIAN MOUNTAINS, penetrating and splitting the BALKAN PENINSULA from EUROPE.

Another main route connects BELGRADE with NAGYKANIZA in southern HUNGARY. This road crosses the DRAVA RIVER south of NAGYKANIZA and gives entrance to the WESTERN HUNGARIAN plains from the NORTHERN YUGOSLAVIA PLAINS.

A strategic route goes south from BELGRADE to NIS, then eastward to SOFIA, BULGARIA. Another road branches south over more rugged terrain branching through the MONASTER GAP and along the VARDAR RIVER to the strategic port of SALONIKA, GREECE. Both of these roads could be considered seasonal roads, and capable of military traffic with constant maintenance.

Another Yugoslav road of doubtful military significance but of possible interest, connects DUBROVNIK a southern coastal city with the SAVA RIVER about midway between BELGRADE and ZAGREB. This road traverses some of the roughest YUGOSLAV terrain, and would be feasible only for light vehicular traffic.

⁴ Bulgaria

The highways of BULGARIA are sparse, with a total mileage of 15,225 miles, representing an average density of .3 miles of

road per square mile throughout the country. There are few roads that have alternate routes, as each main artery follows the only available avenue for movement between principal population centers. There are no modern highways of hard surfaced fast traveled roads. The road with a crushed rock base capable of withstanding more than moderate traffic is the exception.

All roads crossing a major stream present a problem. In 1939, there were 8,299 bridges, but now construction progressed with German cooperation during World War II. It is to be remembered that no large armored movement went across BULGARIA, and native industrial development does not stimulate a need for heavy bridging. Although the existing bridges are of low quality, they are not considered a crucial factor. The mountain bridges are reported to be short enough to be braced for military loads, and streams in valley floors are shallow with gravel floors, which are easily forded in dry seasons.

Movement of armor in BULGARIA would be restricted to the roads and railways that follow canalized avenues of approach, which in many instances restrict movement to single one way traffic. These roads and railways of necessity would require constant maintenance under military traffic. The conditions do not obviate the use of armor, as similar problems were met and overcome by the German Panzer units that operated in the BALKANS, and by American armor in ITALY.

The International Route from CARIBOD, YUGOSLOVIA-SOFIA-PLOVDIV-EDIRNE, TURKEY and on to the NEAR EAST is the most important

route in BULGARIA. This highway crosses the country following a natural route of approach to SOFIA from the southeast. It is approximately 255 miles in length, covering an airline distance of about 200 miles.

From YUGOSLOVIA to SOFIA, a distance of 37 miles, the road averages 20 feet in width, most of which is waterbound macadam, some portions reportedly being asphalt covered. From CARIBROD the road crosses a range for about nine miles, with ten percent grades on each side; then 23 miles west of SOFIA the DRAGOMAN PASS is crossed at an altitude of 2,382 feet. The remaining distance is barren hill areas fringing the SOFIA BASIN, with the ISKR RIVER being the only obstacle. Existing bridges are reported capable of being prepared for military traffic. From the DRAGOMAN PASS to SOFIA, cross country movement is unrestricted, except during flood season from March to June.

From SOFIA to PLOVDIV, a distance of 110 miles, the road does have some short sections of three and four lanes, of surfaced highway. An alternate route along portions of the ISKR RIVER gives some added advantage to the route. There are few very sharp curves on the road, some grades of 10 to 20 percent are found northwest of VAKEREL. A viaduct at IKHTIMAN crossing a minor stream at an altitude of 100 feet is a vulnerable point. Of the important bridges on this road, seven are stone, six concrete, two iron, one wooden, and one of unknown materials. The MARITSA RIVER is shallow, with a firm sand and gravel bottom which is fordable when not flooded. River

banks are likely to be swampy in some areas.

From PLOVDIV to EDIRNE, TURKEY, the road averages 26 feet wide, has no serious grades, and curves are few. Portions are flooded during spring rains, and crossings of the winding MARITSA RIVER are only temporary problem points.

The SOFIA-VARNA highway is another major route approaching SOFIA along the southern foothills of the BALKAN MOUNTAINS from VARNA, the major BLACK SEA port. The road covers a distance of 296 miles, has a mean roadbed width of 20 feet, and although of bound surface, is dusty and rough in places. The road crosses moderately hilly country, but has few steep grades and sharp turns.

The SOFIA-BURGAS route is 258 miles long and was the most used by the Germans as a military road. German engineers strengthened the bridges, and the road was classified as a first class road as such, although some sections are likely to be rough and dusty. There are a few steep grades and bad curves east of SOFIA, but otherwise the road as a whole is not difficult traveling. Between SOFIA and KARLOVO, a distance of 92 miles, the road crosses two water divides which are quite steep and subject to washouts in rainy seasons. Sixty-three miles east of SOFIA the road crosses a low pass, then descends for one and one-half miles through a steep, narrow defile down into the STRUMA RIVER valley, which it then follows to KARLOVO. The rest of the road through STARA ZAGORA to BURGAS is characteristic of roads passing through low foot hills and rolling terrain. There is an important bridge over the TUNDZHA

RIVER west of SLIVE, over the AZMAK RIVER west of KARNOBAT, and over the AITOSKA RIVER west of AITOS.

The VARNA-BURGAZ road is a north-south route along the BLACK SEA coast, connecting the port towns of VARNA in the north with BURGAZ on the southern terminal. The road is 102 miles long, 20 feet wide, has a macadam surface except for a few miles of paving stones near each terminus. Although there are numerous steep grades, the road is usually in good condition. There is an alternate road over most of the route which is impassable in wet weather.

The SOFIA-SERRAI, GREECE route is the principal road from BULGARIA to GREECE, following the STRUMA RIVER valley for a distance of 141 miles between the two points. Several roads branch off toward YUGOSLAVIA to the west. An alternate road exists which is somewhat longer, connecting SOFIA, SAMOKOV, RAZLOG, and SERRAI. This road is characterized by many grade crossings over the railway which it entwines, and numerous grades up to ten percent in slope. The surface varies from granite block paving on the SOFIA to TSRKVA length, waterbound macadam from TSRKVA to KULATA, to tarmac surfacing on the Grecian side. The average width of the road is 23 feet. Critical points exist between FORN DZHUMAYA to LEVUNOVO where the road requires constant maintenance and is usually impassable during wet weather. Another restriction exists in KRESNA GORGE where the road is single lane, has grades up to ten percent, and has no alternate by-passes. There are 18 major bridges between SOFIA and KULATA, with construction varying, but most

consisting of stone masonry or steel. All bridges would require reinforcement for armor loads.

The SOFIA-DRAMA, GREECE road is the more difficult of the two routes from SOFIA to GREECE, covering a distance of 184 miles over mountains and rough country. It has stone-set surface from SOFIA to SAMOKOV, the remainder is macadam averaging 20 feet wide, with numerous bridges and culverts. The route follows the MARITSA RIVER and MESTI RIVER for short distances.

The PLOVDIV-XANTHI, GREECE route connects central MACEDONIA with central BULGARIA. The route was widened to 20 feet by the Germans and was used extensively as a military route. It covers a distance of 102 miles and is characterized by numerous deep defiles, hairpin curves, and steep grades. In narrow valley sections it is subject to flooding. An important bridge is located 12.5 miles south of PLOVDIV over the STANIMOSKA RIVER. The road crosses three rivers and four mountain ranges with grades between 10 and 20 percent in many places.

The KHLARKOVO-KOMOTINE, GREECE road is the best route into EASTERN BULGARIA from GREECE. The road is 16 to 20 feet wide, with crushed rock surface, having grades of 10 to 20 percent. There is a stone bridge just south of KRZHALI, and a simple truss iron bridge just north of MOMCHILGRAD, both are about 400 feet long.

Romania

In 1945 total highway mileage in ROMANIA was reported to

be 43,163 miles.⁶ This makes a density of almost one-half miles of road per square mile, compared to .3 mile of road per square mile in BULGARIA. Due to the ruggedness of the CARPATHIAN MOUNTAINS and TRANSYLVANIAN ALPS, most of the highways are probably in the south along the DANUBE TABLELAND and on the east between the PRUT and SERE RIVERS.

During the latter months of 1944, two Soviet armies swept across ROMANIA. One army swung southward following the DANUBE RIVER, while the other moved along a north central route between the TRANSYLVANIA ALPS and the CARPATHIAN MOUNTAINS, on a general straight east-west line toward ARAD. These two armies were accompanied by a considerable amount of armor which later defeated strong German armor formations in the siege for BUDAPEST.

ROMANIA'S main economic asset is petroleum. In 1939 the output was 45,600,000 barrels which was about two percent of the world's production. In 1948 the production was 34,000,000 barrels.⁵ Although most of the present production of oil may be exported, this natural resource has militated toward better communications in general.

Although detailed information about ROMANIA'S highway system is lacking, it can be assumed from the above information that her highway system is better than the neighboring BALKAN countries.

Hungary

In 1949 HUNGARY'S highways totaled 10,248 miles, with

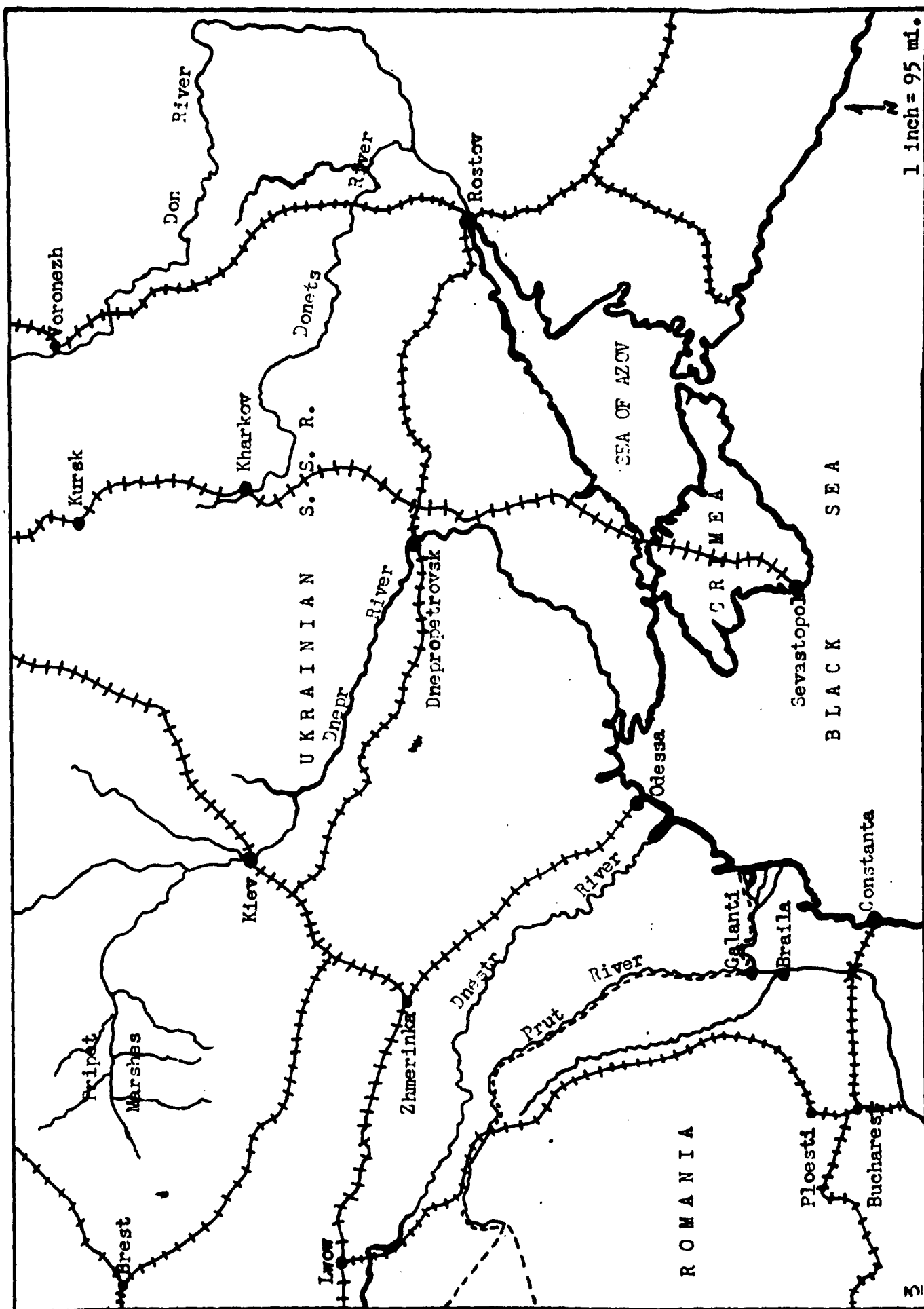
a density of .3 mile of road per square mile of area.⁶ These highways were very heavily used and deteriorated considerably during World War II. The only hard surfaced roads of importance became potholed early in the war from heavy German military traffic. Later battles of large armored formations occurred during the beginning of 1945, on the HUNGARIAN PLAINS surrounding BUDAPEST. These heavy movements all taxed existing trafficable surfaces and bridging to the utmost.

There is no detailed information presented on Hungary's highways, but it is sufficient to assume that due to the rolling plains and river valleys, military cross country movement would not be a big problem.

South European Russia⁷

The highway system of EUROPEAN RUSSIA diverges from MOSCOW in a spider web not reaching out to the borders of the country. There are major belt lines that connect the radiating spokes on transversal planes. For the purposes of this study a general description of the roads in the area of the southern arc and more detailed analysis of major routes approaching MOSCOW from the BALKAN and BLACK SEA areas are presented.

In the southeast sector the VOLGA RIVER valley is the major plain from KAZAN, east of MOSCOW, to the river's mouth in the CASPIAN SEA. This region has a sparse network of roads, with all weather roads being short sections that connect railway



stations with inland water ports. The ASTRAKHAN-KAZAN route follows the VOLGA RIVER, and it is rated as an all weather road with the exception of the STALINGRAD-KAMYSHIN section which is dirt and low grade of gravel which is difficult going in wet weather. There are no highway bridges over the VOLGA RIVER, and only three railway bridges cross this river.

The southwest sector which includes the broad reaches of the UKRAINE, the annexed POLISH TERRITORY, and Bessarabia, is the sector which connects RUSSIA with her major satellite countries. This is also the area where the major part of military operations occurred between RUSSIA and GERMANY during World War II. The great armored and mechanized campaigns that crossed and recrossed this area are yet to be fully documented. Nevertheless, the political significance of this area attests to the probability that considerable improvement of transportation nets have been undertaken in the reconstruction period since the war. The UKRAINIAN network is densest in the western parts and centers around the key cities of KIEV and LVOV. These two points are the focal points of feeder routes that feed into ROMANIA, and across a few narrow passes of the CARPATHIAN MOUNTAINS into HUNGARY. The PRIPET MARSHES, which occupy the area between LVOV-MINSK-KIEV, channelizes this main movement through KIEV. The roads in this general area are mostly dirt roads of a low type which are passable when frozen or dry, but presenting extreme trafficable problems when thawing and during the rainy season.

The MOSCOW-BREST highway connects MOSCOW with the WHITE RUSSIA area centers and leads into POLAND. The route is 574 miles long and was in the process of being hard surfaced with four inches of concrete and 1.2 inches of asphalt when the German invasion was launched. The original paving was destroyed in several stretches and the remainder of the road, for the most part, failed under heavy German mechanized traffic. From MINSK to BREST the route closely skirts the northern edge of the PRIPET MARSHES which increases its seasonal variability. There are 19 known bridges totaling 4,945 feet in lengths on the route. The longest bridge is 1,083 feet which crosses the BEREZINA RIVER and is of timber construction. Near the same place there is a 328 foot steel bridge. In addition to these there are six other bridges totaling 945 feet and six culverts totaling 315 feet. Nine of the known bridges are along the PRIPET MARSHES. The traveled portion of the road is generally about 40 feet wide.

The MOSCOW-KIEV-LVOV-ODESSA route is the major route to and from the BALKAN area, having a terminus at ODESSA on the BLACK SEA, which is 928 miles southwest from MOSCOW. A branch to LVOV on the HUNGARY-RUSSIA border area is approximately equidistant. Not much information is known about the route, except that it is considered to be all weather, regardless of the many lowlands that are crossed. Although numerous rivers are crossed, including the BUG RIVER at PERVOILYISK and the TIGUL RIVER at BEREZOVKA, the identified bridges are restricted to those at KIEV and vicinity. One bridge is a 3,481 foot railway-roadway bridge which was

scheduled for completion in 1941. The other three are steel highway bridges of the following lengths: 820 feet; 2,625 feet; and the longest 5,906 feet. The major barrier crossed by this route is the DNEPR RIVER, which is crossed at KIEV.

The MOSCOW-KHARKOV-SEVASTOPOL-ROSTOV road connects MOSCOW with the CRIMEA PENINSULA over approximately 888 miles of generally good based and seasonally all weather road. The distance from MOSCOW to ROSTOV is about 650 miles, over a route branching southeast from KHARKOV for 307 miles of hilly terrain and consists of a seasonal improved dirt road which is generally impassable for 10 days in the spring, and for heavy traffic after a rain. Most of the major bridges on this route were dual for rail and road traffic and were destroyed during World War II. They have probably been reconstructed to their prewar specifications. The longest bridge of 4,114 feet spans the DNEPR RIVER at KNEPROPETROVSK. Two other long dual bridges were near ZOPOROZHYE. In addition to these three bridges there are 16 others, one of which is a dual double-decked steel structure 1,485 feet long across the OKA RIVER. Near KURSK there is a 590 foot wooden bridge spanning the TUSKOR RIVER, and 984 foot concrete bridge in the same area. At MTSENSK a ferry and a 394 foot bridge crosses the ZUSHA RIVER. The 12 remaining bridges average about 110 feet in length, except the timber bridge across the PSEL RIVER which is 328 feet long. The located and identified bridges between MOSCOW and SEVASTOPOL total 12,668 linear feet of structure.

The route from KHARKOV to ROSTOV is generally all weather with a good base and probably an asphalt finish. The DONETS RIVER is crossed, but no information is available on the specifications of the bridge across this river.

The STALINGRAD-ASTRAKHAN-KAZAN route follows the west bank of the VOLGA RIVER for its entire length of approximately 880 miles. The first 124 miles to YULANOVSK has a good base in part; the next 186 miles traveling to the south is an improved seasonal road to VOLSK; the next 186 miles through SARATOV to KAMYSHIN is an all weather road, built especially for heavy traffic with paving stone base. From KAMYSHIN to STALINGRAD the road reverts to a seasonal road for a distance of 115 miles. The 267 miles from STALINGRAD to ASTRAKHAN have a good base, although heavy traffic causes pot holes requiring constant maintenance. From ASTRAKHAN a road leads inland from the CASPIAN SEA to the CAUCASUS REGION.

The MOSCOW-TAMBOV-KAMYSHIN route runs southeast from MOSCOW for 564 miles to a juncture with the KAZAN-STALINGRAD route at KAMYSHIN on the VOLGA RIVER. For about 170 miles out from MOSCOW the road is all-weather surfaced with asphalt. The road is seasonal in the area near MICHURINSK. The road is mostly all weather east of MICHURINSK, but it is of poorer quality on to the VOLGA RIVER. It passes through several inland river ports. The use of inland waterways in the VOLGA RIVER area probably explains the lack of developed roadways in this area.

Turkey

Highways constitute an outstanding deficiency in TURKEY'S economy. For many years the building of roads have taken second place to the building of railroads. Also, for many years the Turkish rulers have believed the fewer roads, the better for defense. But with modern military methods and present day developments and United States Aid, Turkey is well along on a nine year road building program to construct 14,317 miles of new roads.

The best roads are fairly well graded, water bound macadam, but they have weak foundations that break down under heavy traffic. Most of TURKEY'S roads are little more than dirt tracks that are deeply rutted from heavily laden ox carts which make the bulk of the road traffic.

The main road in the EUROPEAN portion of TURKEY connects EDIRNE and ISTANBUL, the two major cities in the area. This area west of the BOSPORUS STRAITS approximates the same area as MASSACHUSETTS. The main portion of TURKEY approximates the area of TEXAS, and in 1948 total roads amounted to approximately 26,500 miles.⁸

Iran

IRAN, an area about one-fifth the size of the UNITED STATES, has approximately 17,000 miles of highways. In 1949, almost 3,400 miles were asphalted.⁹ Due to low rainfall over most of this large area, surfacing to prevent dust is the main

consideration. The most improved road is the route connecting ABADAN near the PERSIAN GULF with TEHERAN in the north. The road generally follows the railway also running across IRAN in this area. Another important road branches to the north-west running to TABRIZ, at the foot of the CAUCASUS MOUNTAIN area.

Iraq-Syria-Israel-Lebanon.

These four countries provide the NEAR-EAST land corridor between the PERSIAN GULF and the MEDITERRANEAN SEA. With the exception of ISRAEL, the other three countries have rather sparse road nets. ISRAEL has a good road net of 1220 miles of fairly well improved roads over an area of 7,800 square miles. LEBANON, a small coastal nation at the foot of 10,000 foot high mountains ranges, is lacking in highway mileage. The combined areas of SYRIA and IRAQ totals 190,187 square miles, having approximately 8,000 miles of improved and unimproved roads. Most of the central portions of these two countries are arid deserts, with highways mostly in the fertile plains of the TIGRIS and EUPHRATES RIVERS.

NOTES FOR CHAPTER 6

¹ Strategic Study of Greece, ONI-113, Report prepared by the Office of Naval Intelligence (Washington, ONI, July 1943) Vol II, p 569.

² John Kiernan, Information Please, Almanac (New York: The Macmillan Co, 1952) p 510.

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³Op cit, Information Please, p 590.

⁴Joint Army-Navy Intelligence Study No. 38, Military Intelligence Division, War Department General Staff, October 1943, Vol II.

⁵Op cit, Information Please, p 566.

⁶Op cit, passim, p 515.

⁷Joint Army-Navy Intelligence Study No. 40, Military Intelligence Division, War Department General Staff, Brief, Chapter I, pp 1-48.

⁸Op cit, Information Please, p 579.

⁹Op cit, passim p 518.

¹⁰Op cit, passim pp 519; 523; 575.

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